APPLIED Hydraulics & Pneumatics

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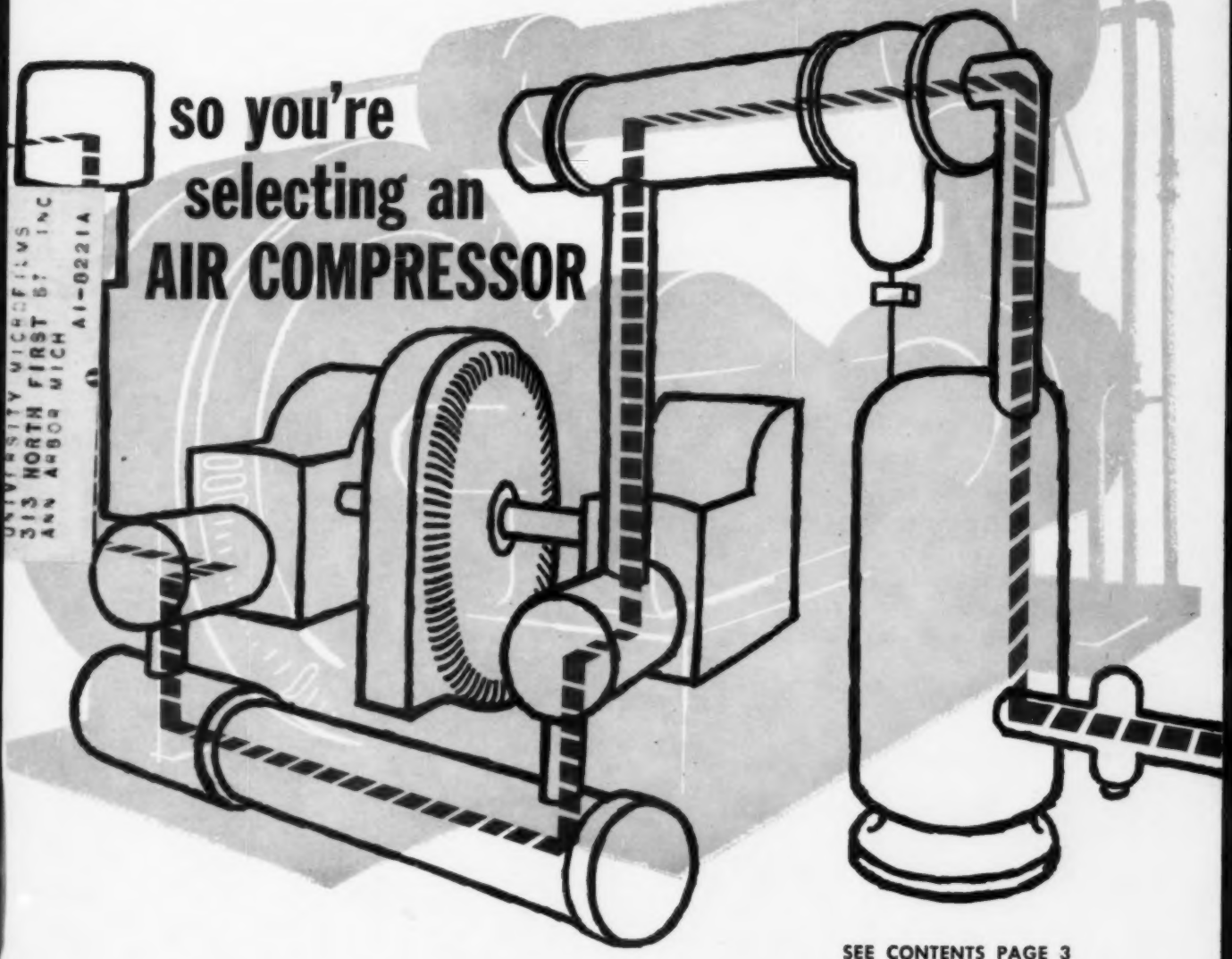

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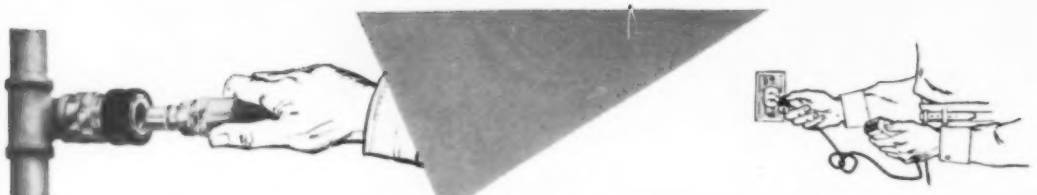
SEE CONTENTS PAGE 3

THE MAGAZINE OF FLUID POWER

PUBLISHED BY THE INDUSTRIAL PUBLISHING CORPORATION

Also in this issue: • *Pulsations in Positive Displacement Pump Flow*
• *Smooth Turnover with Rotary Actuators*
• *Servo's Memory Gives Tug Fast Steering*



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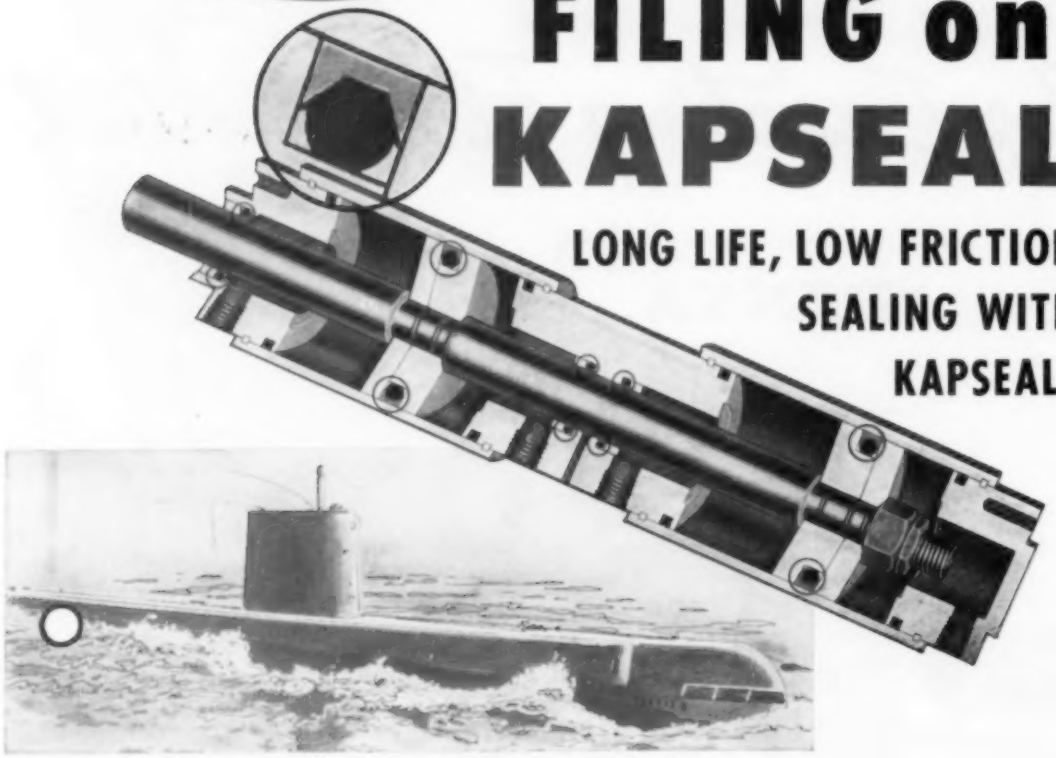

The KAPSEAL® is a Teflon® "boot" which is used with a standard O-ring to provide a good seal with superior frictional and wear characteristics.

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MARCH 1960

THE MAGAZINE OF FLUID POWER

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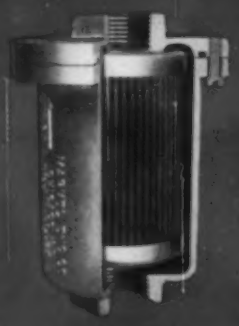

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BY-PASS VALVE:
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For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

Bonded LINE TYPE

CAPACITIES:
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PIPE SIZES:
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Up to 250 p.s.i.

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Up to 300° F.

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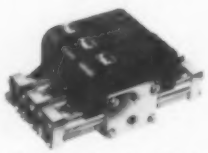

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THE MAGAZINE OF FLUID POWER

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USEFUL LITERATURE

ANCHOR ISSUES NEW HYDRAULIC HOSE ASSEMBLY CATALOG

The new Anchor Catalog No. 102, just issued will be of intense interest to all manufacturers using fluid power for their equipment, or transmitting fluids at high pressures. This new catalog is an expanded, revised and enlarged edition of the former Anchor Hose Assembly Catalog No. 101.

Included for the first time are hose assemblies made from Anchor's new Super-Spiral 4-ply and 6-ply Spiral Wire Reinforced Hydraulic Hose for very high pressures. This new hose opens the way for the use of higher pressures in hydraulic equipment, a long sought objective for many hydraulic engineers. The new hose is made available in assemblies of 3/16" to 2" inside diameter, for recommended working pressures ranging from 12,000 PSI for the 3/16" ID 6-ply hose to 2000 PSI for the 2" ID 4-ply hose. The assemblies can be equipped with several different styles of pressed-on coupling, including "O" ring flanged head straight and angle couplings. All other high, medium and low pressure assemblies included in the broad Anchor line are fully described.

The catalog also includes helpful engineering data and other information of value to hydraulic engineers.

Copies of this new Anchor Catalog No. 102 may be procured by writing Anchor Coupling Co., Inc., 399 N. Fourth St., Libertyville, Illinois.

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ANCHOR ... THE PLEDGE OF PERFORMANCE

FLANCO ASSEMBLIES

For Trouble-Free, Leak-Proof Connections

ANCHOR FLANCO 4-BOLT SPLIT-FLANGE HALVES AND "O" RING, FLANGED HEAD COUPLINGS

- *Stop Leaks*—"O" Ring gasket gets tighter as pressure increases.
- *Prevent Wedging of Pump or Valve Bodies* with tapered threads.
- *Allow repeated disconnection and reconnection without leaks* — No threads to wear — no tapered seats to groove.
- *Reduce Production Costs*—costly threading operations eliminated.
- *Simplify Connections* — no separate swivel or union connections required.
- *Permit Faster, Easier Connections* — to disconnect, only one bolt need be removed.
- Are Available with Pressed-On or Reusable Couplings and with Weld-type Fittings.

Flanco assemblies are your best bet for connection of hose assemblies to valve or pump parts — for hose to manifold — for pipe to pipe, pipe to hose and hose to hose in high, medium and low pressure systems.

Write for Catalog No. 402 for complete description and specifications

Andy Anchor Says:

"When you are faced with a problem in hydraulic plumbing, remember there's a qualified specialist in this field who is always available for consultation — your Anchor representative!"

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FLUID POWER LINES

about hydraulics & pneumatics

COMPRESSED AIR . . . Like electrical power it's the life blood of most industrial plants. Unlike electricity, though, each plant *generates* its own compressed air supply. Compressors are rugged beasts that can work almost constantly with little care. But they need help from time to time as plants grow bigger. Or after many years of service, they have to be retired altogether.

Though it's not a problem that comes up often, selecting an air compressor, and all the auxiliary equipment that goes with it, is one of the most important projects a plant engineer can have. A compressor installation represents a very sizable capital expense. It also represents equipment that's going to have to be lived with for a number of years. So it's worth considerable analysis and planning before deciding on the components.

The compressor article in this issue was written mostly from field experience of men who are planning and installing compressor equipment. It is intended as a "first approach" to make you aware of the various factors you must consider in selecting a compressor and associated equipment.

UP THE RIVER . . . One of Cleveland's less publicized sightseeing tours is up the Cuyahoga River through its industrial back yard. After you've taken it, you realize a tugboats pilot's skill in pushing lake freighters back to the iron ore docks. The servo steering system described in *Servo's Memory Gives Tug Fast Steering* makes his job easier and cuts operating costs too.

SAFETY CIRCUIT . . . There may be a design idea for the outboard motor boat enthusiasts in the article on page 107. It describes the circuit for raising a diesel-powered outboard. As a safety feature, the motor-starter accumulators supply the tilting cylinders and raise the propeller out of the water if it hits a submerged obstruction. Seems as though it could be simplified to an accumulator, hand pump, and sequence valve system for smaller boats.

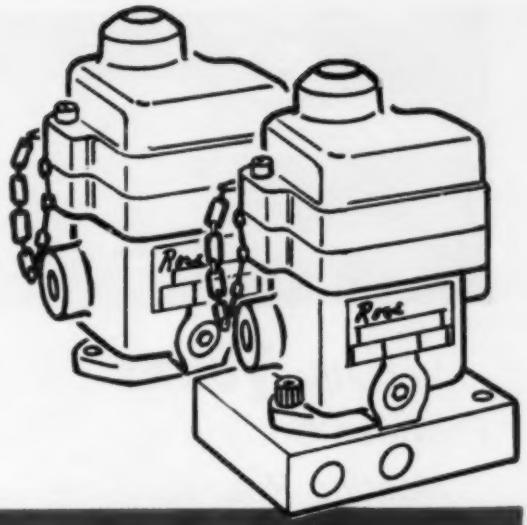
PUMP PULSATIONS . . . Warren Wilson's article on page 79 gives a new insight into the reasons for pulsations in output flow from gear and vane pumps. In addition to conventional pumps, it analyzes a special vane pump design in which the rotor and stator are reversed. Slip and cavitation also affect output pulsation, as the article points out.

HOOKING A BLIMP . . . Raising and lowering the mooring mast for a blimp is a ticklish job. The mast has to mate with the nose cone even when the blimp is bobbing up and down in the wind. A fluid motor driving a screw gives the fast starting and stopping that's needed. The design is explained in *Fluid Motor Positions a Mooring Mast.*

WANT TO SHARE $1400? . . . You can in APPLIED HYDRAULICS & PNEUMATICS Prize Paper Contest. Write up an interesting hydraulic or pneumatic design telling what the original objectives were and how they were achieved. Make a start now by circling No. 240 on the time-saver card.

The Ross PACER gives you 56 new solenoid air valves

The Ross PACER is a fine new solenoid valve in the ⅛" and ¼" size range that gives a full $\frac{7}{16}$" flow capacity yet uses only 7 watts of holding power. The PACER is built for especially long life yet is priced surprisingly low. Capable of 1000 cycles per minute and more, is JIC, and very light and compact. And if you're interested in large valves the PACER has a second identity, that of a pilot section to actuate *any* valve of the Ross Skyline series. It will operate any of these valves at top speed and with low power consumption.

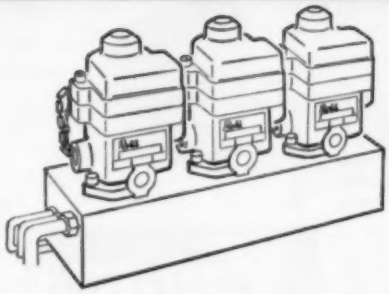


As well as being a complete new valve

...PACER is also a new pilot section in the Ross Skyline valve series...

	PIPE SIZES						
COMPLETE PACER VALVES	⅛"	¼"	⅜"	½"	¾"	1"	1¼"
STRAIGHTWAY, N/C	√	√					
3-WAY, N/C	√	√					
4-WAY	√	√					
SKYLINE VALVES USING PACER AS ACTUATOR (HEAD)							
STRAIGHTWAY, N/C		√	√	√	√	√	√
STRAIGHTWAY, N/O		√	√	√	√	√	√
3-WAY, N/C INLINE MT.		√	√	√	√	√	√
3-WAY N/O, INLINE MT.		√	√	√	√	√	√
3-WAY, N/C, BASE MT.		√	√	√	√	√	√
3-WAY, N/O, BASE MT.		√	√	√	√	√	√
4-WAY, INLINE MT.		√	√	√	√		
4-WAY, BASE MT		√	√	√	√	√	√
4-WAY, 5-PORT		√	√	√	√		

New **PACER** manifolds to save piping and wiring



Ross manifolds provide a compact and economical method of multiple mounting PACER valves. One air supply line and one electrical conduit can serve all PACER valves. Manifolds are available in two and three stations.

STAY AHEAD

MODERNIZE

ROSS OPERATING VALVE COMPANY

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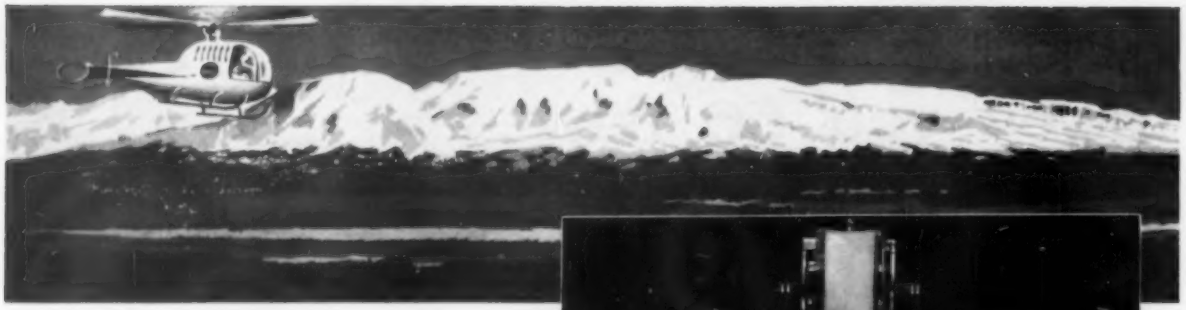
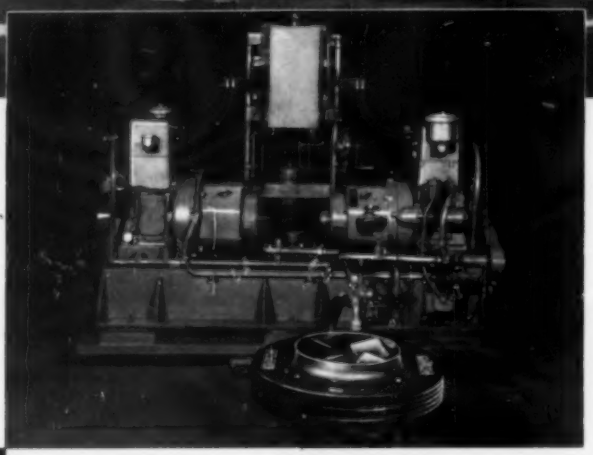




Versatile ***Young*** *Unit Provides Cooling and Heating Requirements for Remote Relay Station on Mountain in Alaska...*

SELECT YOUNG TYPE V JACKET WATER COOLERS

Operates Unattended for Periods of 6 Months or More!

A Young-engineered Type V Jacket Water Cooler was selected to fill an exacting dual cooling and heating job that required utmost dependability at this remote Alaskan telephone relay station. Two engines furnish power for the generator in a continuous 24-hour-a-day operation, (One engine cuts in for five minutes every hour, on a stand-by cycle, to be ready at all times in case of emergency). The Young unit cools both engines and also heats the engine room during the long cold Alaskan winter. Servicing this station is possible only during the short summer months and only by helicopter. Solving unusual heat transfer problems is a specialty of Young engineers. Discuss your problems with them without obligation.

For Dependable and Economical Heat Transfer

CHECK THESE FEATURES

- **Proper Motor Ventilation** — Cool air circulates completely around and through the motor whether it is on or off. Positive motor cooling is assurance of longer motor life.
- **Extra Resistance to Corrosion** — Tubes are of red brass. Aluminum fins are mechanically bonded by drawing an expanded die through the tube to insure permanency of bond.
- **Added Strength and Rigidity** — Tubes are high temperature fusion bonded to the tubular steel headers for long, leak-proof life Headers are braced for added rigidity.
- **Extra Years of Service** — The circular core forms a natural expansion ring, permitting maximum contraction and expansion without undue stress or strain.
- **Maximum Fan Efficiency** — Resiliently mounted slow speed motor. Specially designed fan blades gives greater air flow capacity and lower power consumption.

TYPE H UNIT HEATERS

Economical, low cost heating Type H unit heaters are available in 15 standard models, suitable for steam or hot water application.

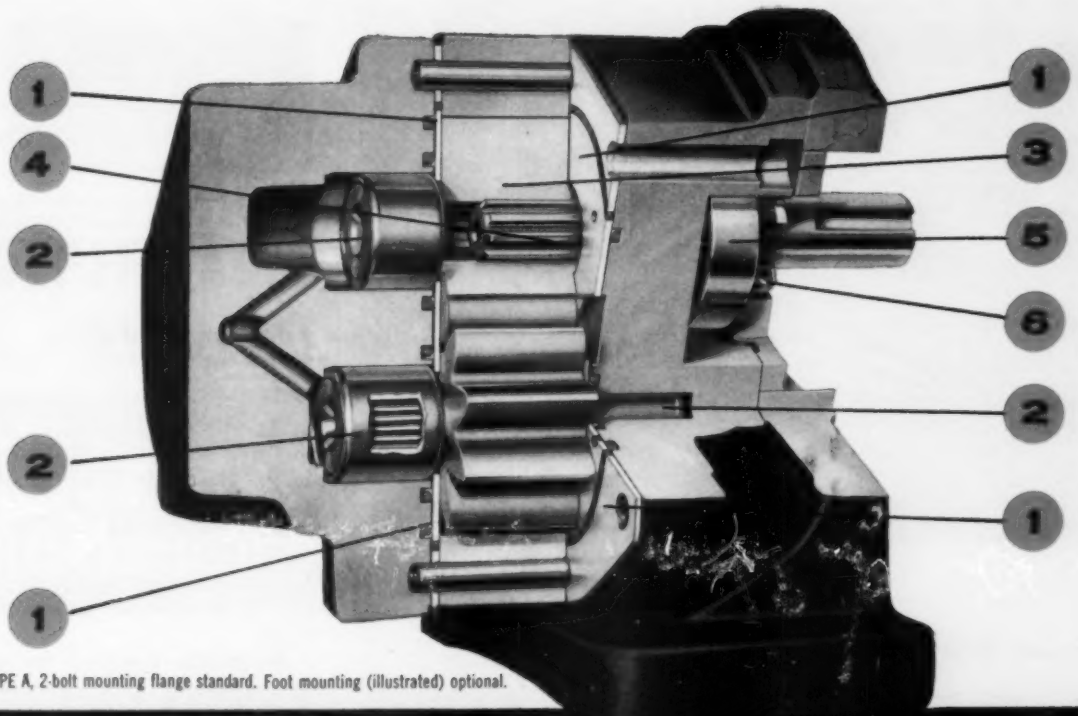
Write to Dept. 440-C for Catalogs 2659 and 2557

Young

ideas for solving heat transfer problems are ***GOOD*** *ideas!*

YOUNG RADIATOR COMPANY

General Offices: Racine, Wisconsin
Plants at: Racine, Wisconsin and Mattoon, Illinois



SAE TYPE A, 2-bolt mounting flange standard. Foot mounting (illustrated) optional.

SAVES UP TO 4 HORSEPOWER!

NEW WEBSTER "J" SERIES HYDRAULIC PUMP

HERE'S HOW WEBSTER PUTS NEW EFFICIENCY IN HYDRAULIC POWER . . . .

1 PRESSURE BALANCED WEAR PLATES — for high volumetric efficiency; prevents clearance changes due to heat.

2 NEEDLE BEARINGS — power-saving, anti-friction operation.

3 ONE PIECE GEAR AND BEARING JOURNAL UNITS — assure minimum deflection and proper alignment on both drive and idler assembly.

4 FREE-FLOATING INTERNAL SPLINE DRIVES - no key failures.

5 THRUST BEARING ON DRIVE SHAFT — absorbs compound driving thrusts.

6 DOUBLE LIP SEAL ON DRIVE SHAFT — gives added protection against seal failure and dirt.

Now — hydraulic power for your biggest mobile rig and the toughest jobs you can put it on. Webster's new "J" pump delivers 2000 psi — does it on less fuel and saves up to 4 horsepower in the bargain!

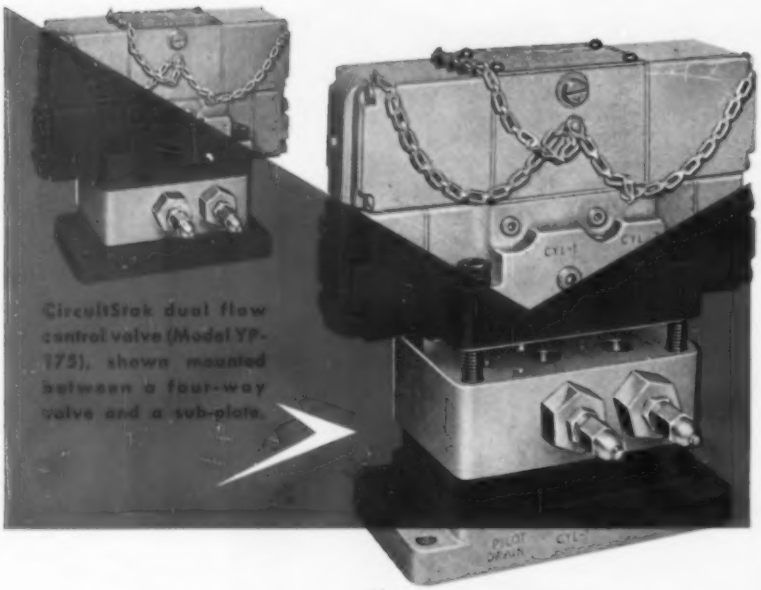
It's the result of a combination of pressure balanced wear plates and anti-friction bearings. Here's top efficiency from all-new Webster design that rates 10% or more above others in competitive ratings. Moreover, you get equally important advanced features (see sectional view) to assure dependable, trouble-free service.

Webster "J" series pump is trim, *very compact* — fits into tight quarters, mounts easily. It's available in 10 sizes from 5 to 40 gpm. Ask your Webster Electric representative for all the facts on this powerful new pump — or write direct for Bulletin HY1-1.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE · WIS



From Brown & Sharpe/Double A—

CircuitStak®

Hydraulic Valve Components

The name CircuitStak covers a whole line of Double A valves. They perform functions such as flow control, relief, reducing, bypass, check, and unloading. They all have this in common: they are placed in a circuit by being "sandwiched" between two other valves, or between a valve and sub-plate.

In themselves, CircuitStak valves require no piping. In new circuits they drastically reduce the size of the valve panel. In existing circuits they can be added without any piping or panel change. They are compact, cost less to use, are from every point of view a sensible, logical valve development. Contact your local Double A hydraulic distributor. Or write to **Double A Products Co.**, a subsidiary of Brown & Sharpe Mfg. Co., Manchester, Michigan.

Brown & Sharpe

HYDRAULICS DIVISION

GEAR, VANE & CENTRIFUGAL PUMPS
DOUBLE A VALVES
GEROTOR PUMPS
POWER UNITS

PROGRESS IN PRECISION FOR OVER 135 YEARS

GET COMPLETE INFORMATION on Double A CircuitStak valves
ASK FOR The CircuitStak Folder

Circle **27** on Time-Saver Card

LETTERS to the editor

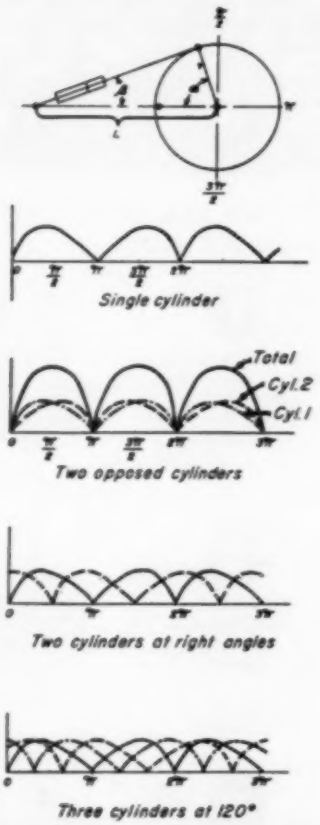
Address your letters to: Editor, APPLIED HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Refinements to Fluid Motor Article

TO THE EDITOR:

The article, "High Torque Motor Has Radial Crank Design" in the November issue contains, I believe, some misleading statements. In the interest of accuracy, I think these should be corrected lest some of your readers be led into some improper design concepts.

Mr. Henke describes the torque as varying from a plus to a

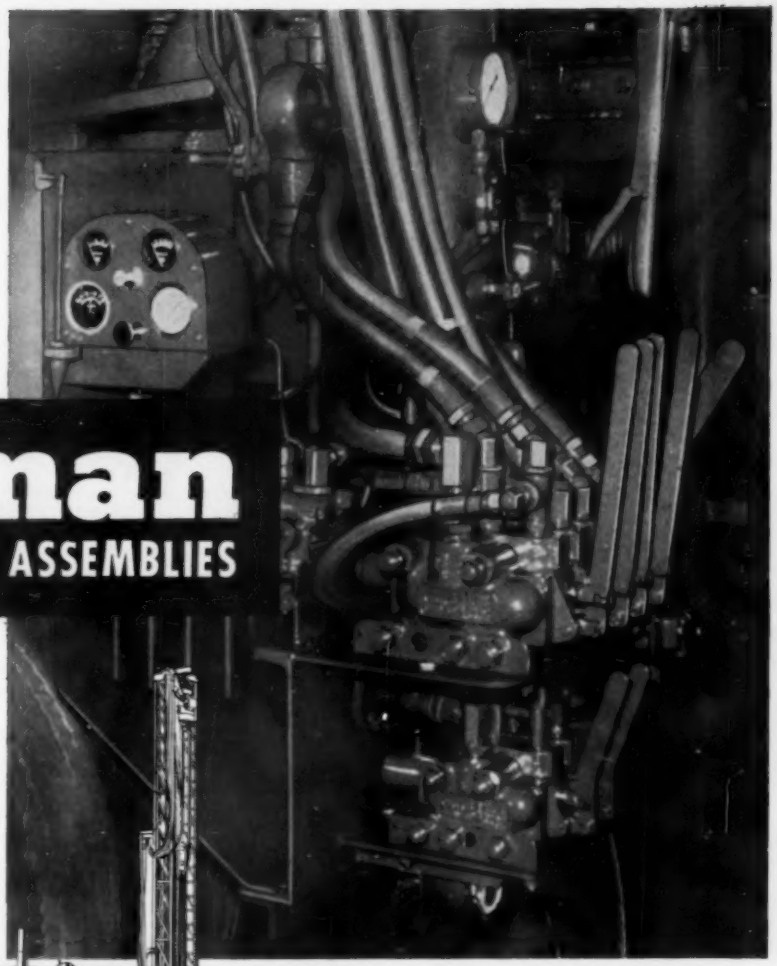


minus value. Obviously, the torque cannot change sign or the motor would not produce work. A more proper convention would be

Continued on page 14

THE KEY TO A DEPENDABLE SYSTEM!

Eastman
HYDRAULIC HOSE ASSEMBLIES



EASTMAN designs complete hydraulic operation for SCHRAMM Rotadrill

Valves mounted in three convenient banks for each outrigger, forward and reverse rotation of motor, slow down speed, rapid down speed and for breakout cylinder.

The cooperation of EASTMAN Engineering was enlisted in making the operation of this truck-mounted Schramm Rotadrill *completely hydraulic.*

Hydraulic power is delivered through EASTMAN Hydraulic Hose Assemblies to:

1. Three-Speed Reversible Rotation Head: Standard speeds—44, 65 and 120 r.p.m. with 26,500 inch pounds torque. 2. Cylinders controlling down feed, rapid feed and slow feed. 3. Controls for raising and lowering of mast. 4. Breakout Cylinder. 5. Hydraulic Winch and Hook. 6. Three Outriggers.

Dependable field service is assured through EASTMAN Two-Wire Braid High Pressure Hose with Permanently Attached Couplings providing a bond stronger than the hose itself.

Efficient power delivery through the extensive, multiple circuits of this rock-drilling rig is obtained through EASTMAN designed permanently attached hose assemblies which insure longer life and lower cost.

ENGINEERED FOR ENGINEERS BY ENGINEERS

Let EASTMAN Engineering assist you in planning the initial layout of your hydraulic system—for most efficient power delivery and lowest cost.

PERMANENTLY ATTACHED COUPLINGS
for 1, 2, and 3 wire braid rubber cover hose

REUSABLE COUPLINGS
for fabric cover hose

REUSABLE COUPLINGS
for rubber cover hose

CLAMP COUPLINGS
for 1, 2, and 3 wire braid rubber cover hose

Write today for Bulletin 100 and 200 on EASTMAN High, Medium and Low Pressure Hydraulic Hose Assemblies.

Eastman MANUFACTURING COMPANY
Dept. AH-3, MANITOWOC, WISCONSIN

microflex
RESET TIMER
20 turn dial provides EXACT timing for industrial processes
The double micrometer dial permits 1200 accurate, visual settings over entire dial range. Set this timer for 18 minutes 6 seconds or any other exact time setting required.

Savings

- Large 15 ampere contacts eliminate additional load relays.
- Stop down time with plug-in components for fast timer replacement.

Flexibility

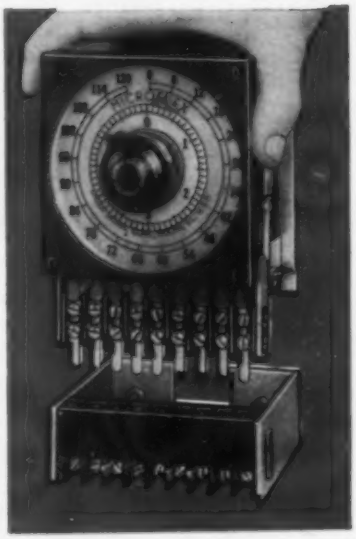
- Easy to set dial whether short or long timing.
- Choice of 9 actions available for each of 3 contacts. Select operation required for your circuit.

Accuracy

- Set dial to exact time required. No guessing at numbers.
- Accurate repeatability insures uniform production.

Reliability

- Proven reliability in thousands of industrial processes for more than 25 years.



Install timer in seconds with optional plug-in feature.

EAGLE SIGNAL COMPANY
Industrial Timers Division, Dept. AH-348
MOLINE, ILLINOIS

Please send FREE Bulletin 110 containing complete data on Microflex Reset Timers.

NAME AND TITLE

COMPANY

ADDRESS

CITY ZONE STATE

Circle 51 on Time-Saver Card

LETTERS

to choose torque as positive when motion is clockwise.

More important, however, is the fact that torque does *not* vary sinusoidally. Referring to the drawing, maximum torque occurs when

$$\alpha = \cos^{-1}\frac{r}{L} \text{ or } \beta = \sin^{-1}\frac{r}{L}$$

From the laws of similar triangles,

$$\alpha = \frac{\pi}{2} - \beta$$

when torque is maximum. The variation can be sinusoidal only when the actuating piston is mounted infinitely far from the center of rotation of the crank. The actual torque output of such a device is shown.

With the condition of two opposed actuators, the same reasoning leads to curves shown. Neither the individual nor total outputs are anywhere near sinusoidal. This mistake might be quite important if the motor were to be used for timing or regulating purposes as well as supplying pure power.

As the article has concluded, one must leave the in-line designs if periods of zero torque are to be avoided. However, my plot of the output of two cylinders at right angles shows no indication of the "sinusoidal gallop effect" mentioned. The clockwise notation is the key to this difference in analysis.

The continued addition of cylinders provides for greater smoothness of operation. The number seems to me to be a function of (1) the acceptable level of smoothness, (2) the complexity of design, and (3) the relative cost of additional cylinders. Mr. Henke did not, at least in those terms, discuss this enough to show why four cylinders should be used rather than three or five or six.

GEORGE R. KELLER
Autonetics Div.
North American Aviation, Inc.
Downey, California

TO THE EDITOR:

Thank you for forwarding Mr. Keller's letter commenting on the

Continued on page 16

Circle 114 →

. . . Fluid Power news

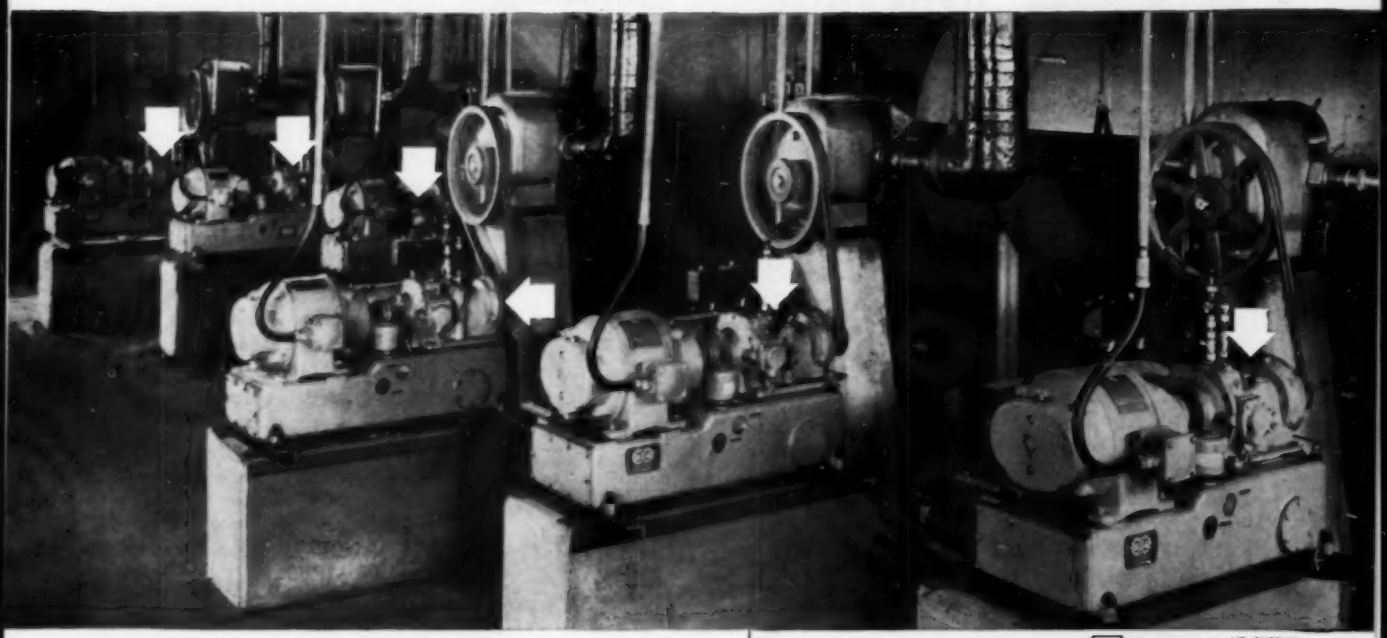
REPORT NO. 11,300 NEW LIQUID LEVEL CONTROL

From Oilgear Application-Engineering Files

HOW OILGEAR DRIVE AND CONTROL SYSTEM STABILIZED BEER FILLING LEVEL

CUSTOMER: *Large Western Brewery (Name witheld by request)*

DATA: Highly carbonated beverages must be handled gently. Throttling flow of beer into filling machine reservoirs causes foam and irregularity of liquid height, making accurate filling of cans or bottles difficult. These reservoirs are small compared to the flow through them. Costly losses are incurred on tax-paid cans "in process" due to under or overfilling. Any beer pump drive-control system must respond immediately, have smooth action, and be unaffected by daily wash-downs required to maintain sanitary operations. Accurate automatic control, dependable operation, and ease of maintenance—as always—are important factors in the selection of this equipment.



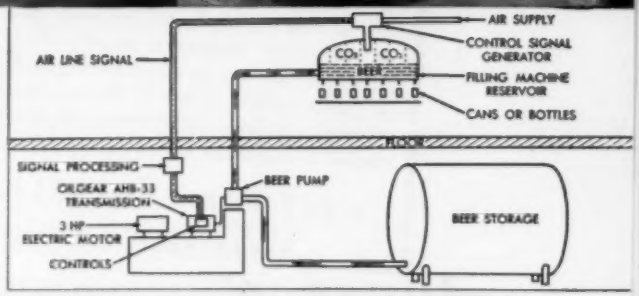
SOLUTION: Shown "on the job" above, are 6 Oilgear AHB-33, two-way, "Any-Speed" transmissions driven by 3 hp electric motors, mounted on standard reservoir bases. Transmissions drive beer pumps through dual "V" belts. Beer is pumped from storage tanks to bottle or can filling machine reservoirs on the floor above. Liquid level in filling reservoirs is controlled automatically by a low pressure CO_2 signal . . . as level rises, pressure rises . . . as level falls, pressure falls. Translated to air pressure signals, which, transmitted to controls on Oilgear transmissions, automatically-instantly increase, decrease, reverse, or stop the beer pumps. Where former throttling system caused foam and irregular levels, this Oilgear system holds reservoir level to $\pm 1/16$" under continuous operation . . . assuring accurate filling of each can or bottle. Beer pumps are flushed under water pressure without disconnecting drives. Several years of continuous service have proven drives to be extremely dependable under all conditions, with little or no attention.

Oilgear Application-Engineering can also provide practical solutions to your linear or rotary drive problems. Call the factory-trained Oilgear application-engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

1564 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN



Similar Oilgear "Any-Speed" drives have improved performance on can closing, filling; paper, printing, textile, tape, and rubber processing machines; extruders, capstans, winders, stokers, centrifuges, gang-saw feeds, saw mill carriages, conveyors, and the like. They provide efficient conversion of any constant rotary motion to accurately controlled variable rotary motion . . . smooth, stepless, uniform acceleration from zero to maximum in either direction . . . manual, hydraulic, electric or electro-hydraulic controls—providing complete flexibility of location . . . low power consumption—using power only in proportion to work performed . . . durable, trouble-free, low maintenance due to simplicity and automatic lubrication of all rotating parts.

Keep YOUR HYDRAULIC SYSTEM Clean with HILCO HYDRAULIC OIL FILTERS

- No More Varnish and Sludge Deposits
- No More Flushing and Manual Cleaning
- No More Frequent Oil Changes
- No More Accumulation of Dirt

Filter life up to a year eliminates usual frequent draining, refilling of systems.

HILCO Hyflow Oil Filters trap dirt, acids, rust, sludge, gums, resins . . . all solid contaminants, and keeps your hydraulic system clean and in top running condition at all times. To you, this means longer oil life, reduced wear and abrasion . . . hence, less down time and lower maintenance costs giving you continuous equipment operation with increased production. Hydraulic unit sensitivity depends upon a clean system. HILCO Hyflow filters remove solids as soon as they enter the system and retain much of the moisture which enters the oil from the atmosphere and from condensation. Obtain the full capacity and economy of your equipment by keeping it in top running condition with HILCO. Hydraulic Oil Filters come in stationary or portable models. They can be hooked into hydraulic systems without interrupting equipment operation.

HILCO
OIL RECLAIMER

For complete oil reclaiming. Removes solids, acids and volatile impurities; moisture, solvents, gasses, etc., from hydraulic fluids by heat-vacuum process.

• SEE FOR YOURSELF HOW HILCO keeps your Hydraulic System Clean . .

WRITE TODAY FOR THIS *Free* BOOKLET

Recommendations at no Obligation

THE HILLIARD *Corporation*

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LETTERS

hydraulic motor article. I'm indebted to him for taking the time to run through the analysis.

Of course, he is right from a precise point of view. The illustrations I used to make my points in the article were not intended to be precise or unique, but only as illustrations. The idea was merely to get the point across on why one cylinder would not do, two were better, etc. I probably should have made a much greater issue of this situation rather than assume each reader would see that a precise analysis was not intended.

One factor that led to this oversight was that the motor was thought of as a component to transmit motive power, the idea having been generated by a road machinery requirement. I never thought of it in a control application as an actuator.

That little damage has been done, is evidenced by the heavy correspondence I have had on the motor—all of which has been of an application nature in heavy equipment.

Still, I am happy that Mr. Keller brought up the point in case someone *was* thinking in terms of a control application and took the illustrations too literally.

Russ Henke
Russ Henke Associates
Elm Grove, Wisconsin

Error in New Product Information

TO THE EDITOR:

The Valvair *Speed-King*, ¼-in. 4-way valves, described in the New Product column of the December issue were incorrectly identified as 1¼-in. valves.

Carl K. Campbell
Chicago District Manager
Valvair Corp.
Akron, Ohio

Need Manifold Information

TO THE EDITOR:

We are interested in obtaining any information or articles concerning the building of laminated type hydraulic manifolds. We

Continued on page 18

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DENISON HydrOILics

This AUTOMATIC truck handles hefty steel coil like a baby with smoother, safer DENISON hydraulic power

FLUID POWER

HYDRAULIC HANDLING *for steel coil. This "Skylift Giant" unit was developed by Automatic Transportation Co., Chicago—Division of Yale & Towne Mfg. Co. The "Coil Up-Ending Attachment" is powered by Denison Axial Piston hydraulic pumps.*

FLUID POWER for this "Skylift Giant" industrial truck—equipped with a special "Coil Up-Ending Attachment"—means it can easily heft rolls of coiled steel weighing from 10 to 40 tons. *Denison hydraulic power pays off here in smoother, faster, safer handling.*

In leading mills, these heavy-duty trucks speed handling and storage without damaging coils. The Coil Up-Ending Attachment enters the coil's inside diameter with a fixed ram . . . while the outside is gripped by a powerful hydraulic clamp. This clamp-and-ram design prevents "telescoping" of coils during handling.

Three hydraulic cylinders—powered by motor-driven Denison 3,000 psi Axial Piston Pumps—furnish lifting and clamping power. All three cylinders are connected hydraulically in parallel, which results in a telescopic-cylinder action—but has the added advantage of retaining equal force and speed throughout the stroke at constant pressure and delivery.

Result: Operator easily controls lowering speed at any level . . . and can inch the load up from extremely slow speed to maximum for which the flow control is set. *Safe, fast, smooth hydraulic control helps keep "Skylift" trucks continuously on-the-job . . . handling extra payloads.*

Here's the kind of job your Denison Hydraulic Specialist can help *you* do *now*. Call him in. See how Denison hydraulic power can help put *more payload into your equipment.*

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road • Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON
HYDRAULIC POWER

Actual unretouched photos of MARSH 616 Square-Shouldered Cups and Square-Shouldered Flange used in the test below

MARSH 616 gives the most rugged packing for severe operating conditions — sealing petroleum hydrocarbons and aqueous or non-aqueous base fire-resistant fluids. Temperature range: –65° to +212° F. Made of . . .

Thermo — the finest retan packing leather — condensed in area and thickness to create toughness and higher tensile strength with . . .

Elastomer impregnation with polymerization within the leather structure. The resulting polymer has no *melting point* and cannot be removed by any hydraulic fluid.

RECENT RESULTS IN PYDRAUL* F-9 PHOSPHATE ESTER BASE FLUID show the "universality" of the MARSH 616 packings.

1 LESS than 2% swell by volume.

2 STATIC SEALING for 12 months at 5000 psi with no leakage.

3 CYLINDER TESTS under load, with temperatures up to 130°F—1,000,000 strokes with positive seal and no packing damage.

4 SATISFACTORY field application.

NOTE: Complete test reports on the Pydraul test results are available upon request.

*MONSANTO CHEMICAL CO. T.M. REG. U.S. PAT OFF. FIRE-RESISTANT FLUID

WRITE FOR OUR NEW BROCHURE COVERING THE 612 BACK-UP WASHERS MADE OF THERMO AND ELASTOMER

C·W·MARSH COMPANY

MAIN OFFICE AND FACTORY: MUSKEGON, MICHIGAN

SALES OFFICES: 3756 West Devon Ave. Chicago 45, Ill. · 101 Park Avenue New York 17, N. Y. · 1900 Euclid Ave. Cleveland 15, Ohio

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LETTERS

would like to know the following: how the plates are bonded together, the methods of holding the plates during the bonding process to keep them from parting and leaking between channels, the bonding material, and the type of steels used for such manifolds.

OSCAR ANDREWS
Machine Designer
Franklin Electric Co.
Bluffton, Indiana

Name of a manufacturer offering this type of manifold has been sent.

Designers Guide Corrections

TO THE EDITOR:

In the January 1960 Designers Guide issue, several additional product classifications should have been included for the Anchor Coupling Co., Inc. In the chart, "Fittings, Hose & Assemblies," permanent fittings should have been included for high, medium, and low pressure assemblies. Also flange fittings should have been shown for low pressure.

Anchor should also have been included in the "Fittings, Tube" chart. They supply both flare and flareless types in brass and steel for industrial and mobile applications. Pressure ratings range to more than 3000 psi. Fittings are available with both straight threads and pipe threads for tubing to 2 in. The fittings can be used with any of the fluid media shown in the chart.

F. OHLRICH
President
Merchandising Advertisers, Inc.
Mount Prospect, Illinois

TO THE EDITOR:

In the Product Review section of your January issue, you incorrectly stated accuracy of the Marsh Instrument Co. *Master-Test* gage. It is accurate within ¼ of 1%, plus or minus, of the maximum dial reading over the entire range.

W. H. MELOAN
Kreicker & Meloan, Inc.
Chicago, Illinois

The gage is correctly described in this month's New Product section.

BLAMING COIL BURN-OUT ON THE SOLENOID? THEN TAKE A CLOSER LOOK AT THE **VALVE!**

~~SPOOL and POPPET Valves bind and stick as dirt collects... overload solenoid and cause coil burn-out.~~

"Shear-Seal" Valves are not sensitive to dirt... always retain solenoid power margin.

D.C. SOLENOID "Shear-Seal" VALVES 0 to 10,000 P. S. I.

A.C. SOLENOID "Shear-Seal" VALVES 0 to 10,000 P. S. I.

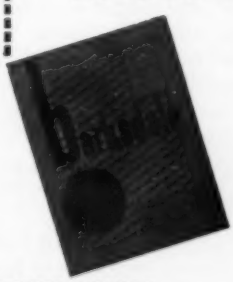
EXPLOSION PROOF A.C. and D.C.

SOLENOID "Shear-Seal" VALVES 0 TO 10,000 P. S. I.

~~SPOOLS and POPPETS leak... can't compensate for normal wear.~~

"Shear-Seal" Valves stay leakproof... a spring takes up the normal wear.

ASK FOR CATALOG V-59-60



CONTROL VALVE DIVISION

barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

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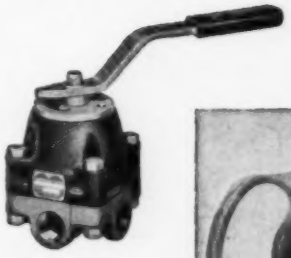
For High Pressure (to 6000 P.S.I.)

MANUAL WATER VALVES

that last

Specify " SHEAR-SEAL " design



4-Way, Manipulator, Dual pressure and Shut-off Valves from ¼ to 1½" N.P.T.

Note the mirrorlike sealing surfaces on this Dual Pressure Valve rotor after 4 years of service.

On extrusion presses, die casting machines, rubber and plastic molding presses and on blowout preventers, they have performed without maintenance longer than any other type of valve.

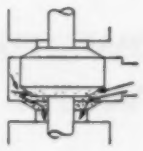
This LONG, MAINTENANCE-FREE SERVICE is possible because the metal-to-metal sealing surfaces are self-aligning and actually improve with use through continued lapping action. Sealing qualities do not diminish because a spring compensates for the wear.

DIRT CANNOT SCORE SEALS because flow is through "Shear-Seals," sealing surfaces remain in constant intimate contact.

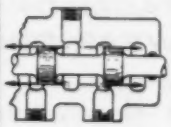
COMPLETE CONTROL OF YOUR CIRCUIT because "Shear-Seal" design is excellent for throttling. It permits opening to any desired degree of flow with smooth action and without fighting fluid pressure.

The "Shear-Seal" action eliminates line surges and the round tubular flow passages provide more flow and velocity capacity (up to 60 ft. per sec.) because they are unobstructed by spools or poppets.

This is why we don't use **SPOOL OR POPPET DESIGN**



Poppets score



Spools leak

Write for Catalog V-59-60

CONTROL VALVE DIVISION

barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

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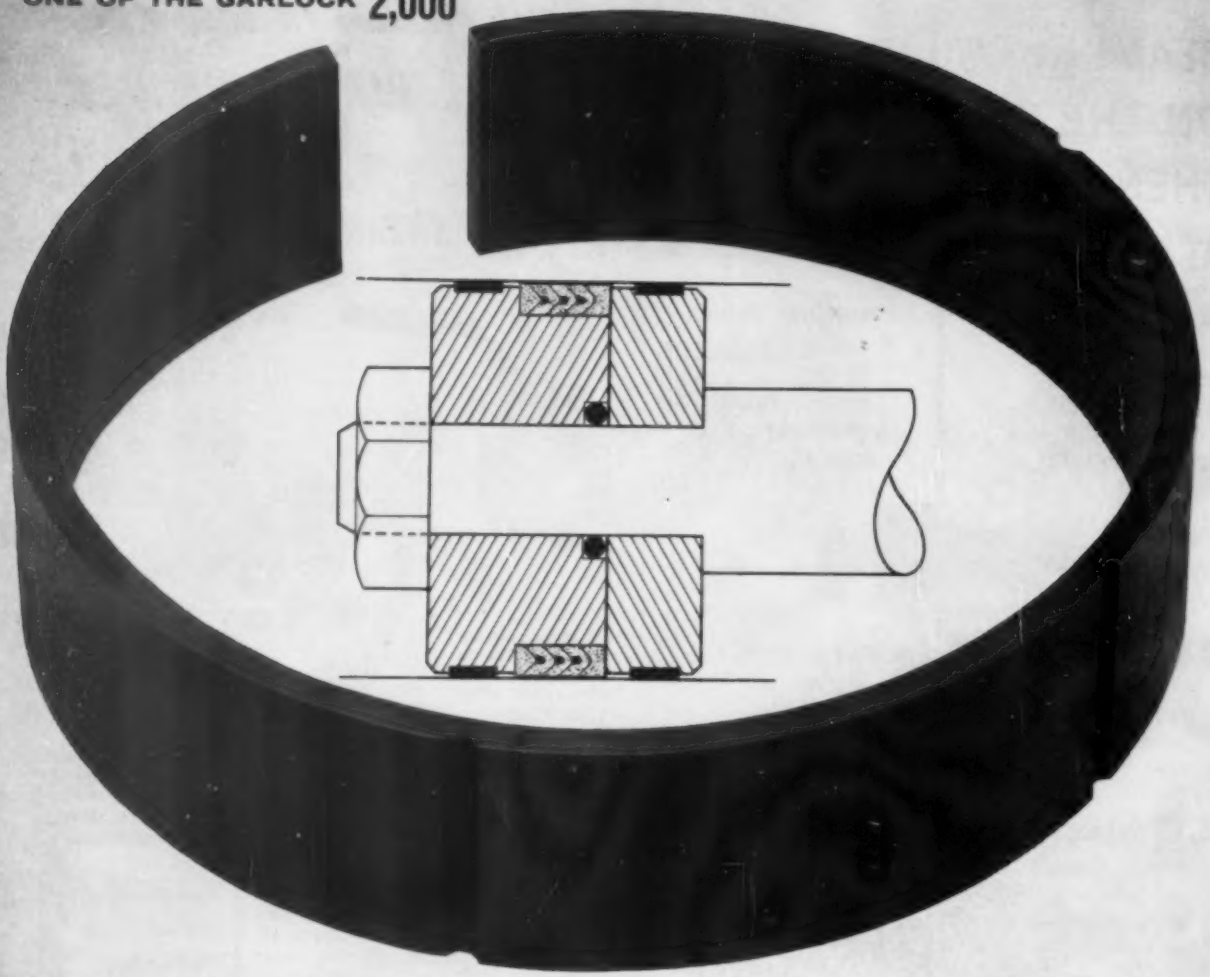
ONE OF THE GARLOCK 2,000



NOW...PREVENT DAMAGE TO PISTON CYLINDERS WITH NEW GARLOCK NYLON WEAR RINGS

COMPARE THE FINE ADVANTAGES OF NYLON WITH OTHER WEAR RING MATERIALS:

- Higher Temperature Resistance (350°F)
- Greatly Extended Life
- Much Better Wear Qualities

Garlock Nylon Wear Rings are harder, smoother... will not pick up foreign particles in the cylinder . . . have no imbedded materials that can score cylinder walls. For you it adds up to smooth, unhampered piston operation, greater overall efficiency, and longer cylinder life.

Specify Garlock Nylon Wear Rings. They're available in many sizes for new equipment, and will fit existing grooves in present equipment. Talk it over with your local Garlock representative. He can choose from "the Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need. Or, write

THE GARLOCK PACKING COMPANY, Palmyra, N.Y.
For Prompt Service, contact one of our 26 sales offices and warehouses throughout the U. S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

Canadian Division: The Garlock Packing Co. of Canada Ltd.

Plastics Division: United States Gasket Company

Circle 60 on Time-Saver Card

Over 30 years of variable volume vane pump experience

CURRENT MODEL Q
PUMP — 5 GPM — 1000 PSI

THOUSAND upon THOUSANDS of RACINE-SECO variable volume vane pumps are serving industry today. A testimonial to the greatness of this principle of pump construction and operation. Today's pumps are designed with the experience of 30 years in a young industry.

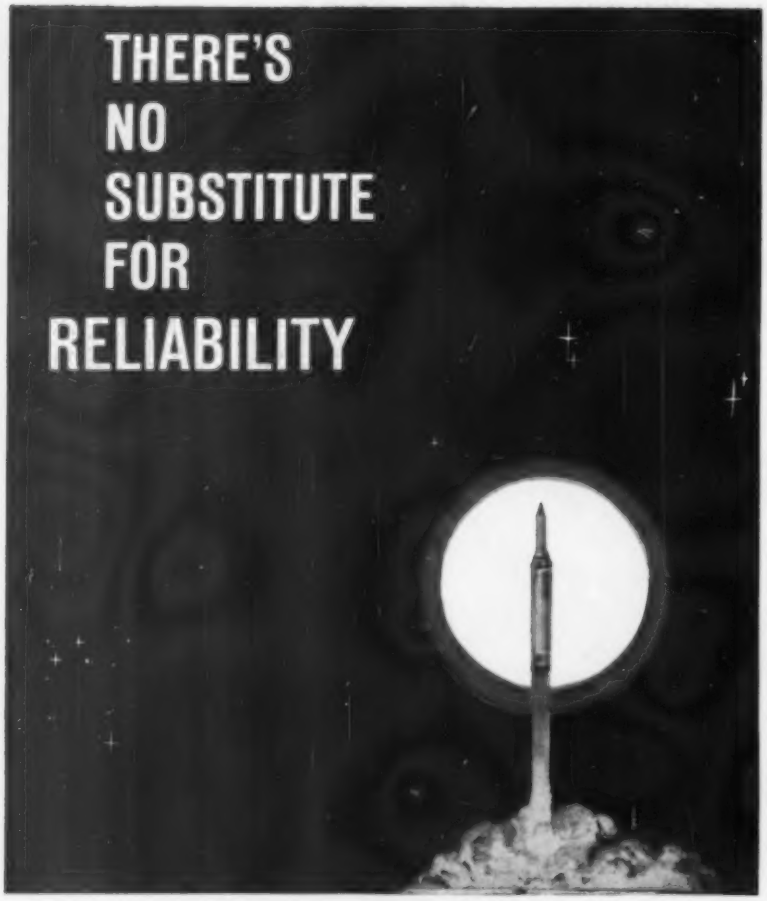
In particular, this is the 7th anniversary of the introduction of the 5 GPM Model Q Pump. During these 7 years, *of field application experience*, design changes have been made to improve the efficiency and life of the pump. Buy the pump with built-in experience.

Put this engineering experience and know-how to work for you, too. Write us today. Representation in all principal cities.

RACINE SECO

RACINE HYDRAULICS & MACHINERY, INC.
RACINE, WISCONSIN

One Source — One Responsibility for all your hydraulic circuit needs



BE SAFE WITH PRECISION "O" RINGS

The more critical the sealing requirments, the more reason to specify Precision "O" Rings. Your investment in Precision quality will reduce assembly costs, rejects and product failures.

Reliability is built into Precision "O" Rings by scientific compounding and a series of over 100 rigid quality control tests and inspections. They're engineered to serve your specific requirement.

For the best in sealing, write, phone or wire for the services of a Precision "O" Ring Specialist today.

*The U. S. Army Missle Juno II requires complete component reliability . . . uses Precision "O" Rings.

Specify Precision—first in Quality

Precision Rubber Products Corporation • "O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio Canadian plant at: Ste. Thérèse de Blainville, Québec

Circle 168 on Time-Saver Card

FUTURE EVENTS

April 18-19
3RD ANNUAL CONFERENCE ON AUTOMATIC TECHNIQUES
Sponsored by ASME, IRE, and AIEE
Cleveland-Sheraton Hotel
Cleveland, Ohio

April 21-22
ASME-SAM MANAGEMENT CONFERENCE
Statler-Hilton Hotel
New York, N. Y.

April 21-28
ASTE TOOL SHOW & ANNUAL CONVENTION
Detroit, Mich.

April 25-26
ASME MAINTENANCE & PLANT ENGINEERING CONFERENCE
Chase-Park Plaza
St. Louis, Mo.

April 25-29
1ST INTERNATIONAL COMPRESSED AIR & HYDRAULICS EXHIBITION
Empire Hall
London, England
concurrent with the 2nd European Fluid Power Conference

May 9-11
SPRING MEETING, NATIONAL FLUID POWER ASSOCIATION
Grand Hotel
Pt. Clear, Alabama

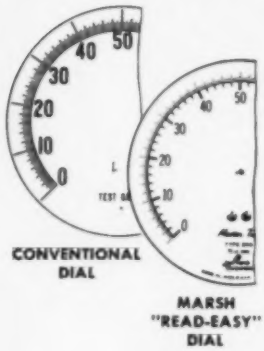
May 11-14
MEETING, FLUID CONTROLS INSTITUTE, INC.
The Greenbrier
White Sulphur Springs, W. Va.

May 23-26
DESIGN ENGINEERNG SHOW
Coliseum
New York, N. Y.

September 7-15
2ND COLISEUM MACHINERY SHOW
Chicago Coliseum
Chicago, Illinois

October 20-21
16TH NATIONAL CONFERENCE INDUSTRIAL HYDRAULICS
Sherman Hotel
Chicago, Illinois
for additional information contact Leroy A. Wickstrom, Illinois Institute of Technology, Chicago 16, Ill.

Presenting New MARSH "*Master-Test*" SERIES
of extremely accurate test gauges



Crowning achievement in instrument making... this superb series of test gauges developed to meet today's exacting requirements of instrument men throughout industry. Accuracy and dependability beyond compare...each gauge individually dead-weight tested (think what that means!)...each gauge guaranteed accurate within ¼ of 1% plus or minus of the maximum dial reading over the entire range.

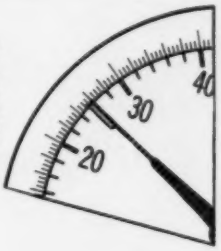
To provide reading accuracy in keeping with the accuracy of the instrument, all "Master-test" gauges have the simplified "Read-easy" dial (patent pending) illustrated opposite—a dial that can be read with the accuracy of a caliper, yet with the ease of a clock.

To further increase accuracy, three advanced means of reading have been developed as described below: the "twin-tip" pointer; the mirror path; the non-parallax dial.

"Master-test" gauges are available in sizes 4½", 6", 8"...in all standard ranges from 0-15 to 0-30,000 psi...in vacuum and compound types...in a full range of case patterns. Ask for 20 page bulletin.

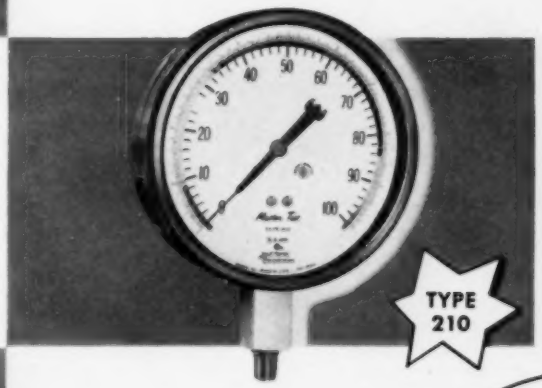
← with "Twin-tip" pointer

The most common error in reading pressure occurs when the observer reads from an angle rather than "dead on". This Marsh "Twin-tip" pointer enables the operator to know when he is dead on by lining up the two tips so that only one is visible. The twin-point arrangement is similar to the sights on a rifle.



with mirror dial →

Another method of insuring accurate "dead on" reading. Knife edge pointer is reflected by the mirror path. When reflection is not seen, reading is dead on and true. The ease and accuracy with which the mirror dial may be read cannot be duplicated by any other mirror type dial. It is the combining of the mirror path with the exclusive Marsh "Read-easy" dial that makes this faster, error-free reading possible.



← with "Non-parallax" dial

This Marsh development eliminates mistakes in dial reading even if read at an angle. To accomplish it Marsh engineers designed a clear Plexiglas insert placed, as shown, over the fine graduations so that they appear to be at the same level as the pointer regardless of the viewing angle. The "Non-parallax" dial provides the easiest and most accurate dial reading available.

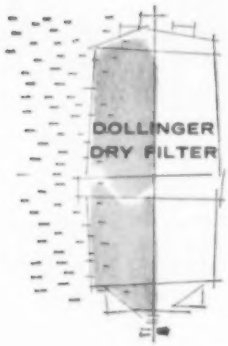
Ask for this 20 Page Bulletin

MARSH

THE STANDARD OF ACCURACY

MARSH INSTRUMENT COMPANY, Dept 19, Skokie, Ill.

Division of Colorado Oil and Gas Corporation • **Marsh Instrument & Valve Co., (Canada) Ltd. 8307 103rd St., Edmonton, Alberta, Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas**



SPECIALISTS
FOR 39 YEARS

RESIST SYNTHETIC OIL TO 300° F

Filters for sump pumps and hydraulically operated equipment

DOLLINGER STAYNEW SUMP FILTERS are designed with new molded end seals of special plastic impervious to all synthetic oils, mild acids, coolants and water to 300° F. Filter medium is a mesh cloth available in either 60 or 100 screen depending on efficiency required and fluid viscosity. Exclusive radial fin design offers the greatest active filtering area in any given space. Staynew Sump Filters can be installed single or in multiple units . . . come in eight standard sizes with capacities from 5 to 100 GPM. Leading manufacturers specify Staynew Sump Filters for positive protection against dirt, sludge, rust and abrasive particles that cause expensive pump failures. Ask your local Dollinger representative for more details. Or, write for Bulletin 330-H. Dollinger Corporation, 65 Centre Park, Rochester 3, N. Y.

PROTECTOMOTOR
STAYNEW
FILTERS

DOLLINGER

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

Circle 48 on Time-Saver Card

Specify the

T-J Spacemaker

for longer, more efficient cylinder service

You too—can reduce replacement expenditures—lower maintenance costs with the T-J Spacemaker cylinder line. Designed and engineered for ruggedness, and accuracy of operation, the Spacemaker assures longer, uninterrupted operation.

The T-J Spacemaker eliminates tie-rods, gives greater strength, saves space . . . and reduces costs in all push-pull operations. Immediate delivery in a complete range of styles and capacities . . . air or oil. Write for Bulletin SM 155-4, today. The Tomkins-Johnson Company, Jackson, Michigan.

With Extras . . . At No Extra Cost

1. METAL PISTON ROD SCRAPER—protects rod packing, cylinder bore and rod surface by removing all foreign particles.
2. NEW "SUPER" CUSHION for air or METALLIC SELF-ALIGNING MASTER CUSHION for oil.
3. HARD CHROME PLATED CYLINDER BORES AND PISTON RODS for greater protection and reduced wear.
4. ONE PIECE PISTON assures better alignment, longer bearing and packing life.
5. FORGED SOLID STEEL HEADS throughout entire line.
6. PILOTED PACKING GLAND with extra long bearing for additional strength and support to piston rod.
7. NO TIE-RODS TO STRETCH—gives you 360° port rotation . . . less space used . . . full strength.
8. STREAMLINED DESIGN . . . operating pressures to 200 PSI, air; 1,000 PSI oil, non-shock.

T-J TOMKINS-JOHNSON

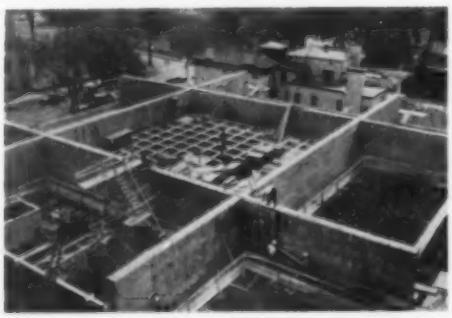
DIVISORS . . . AIR AND HYDRAULIC CYLINDERS . . . CUTTERS . . . CLINCHORS

BRIEFS

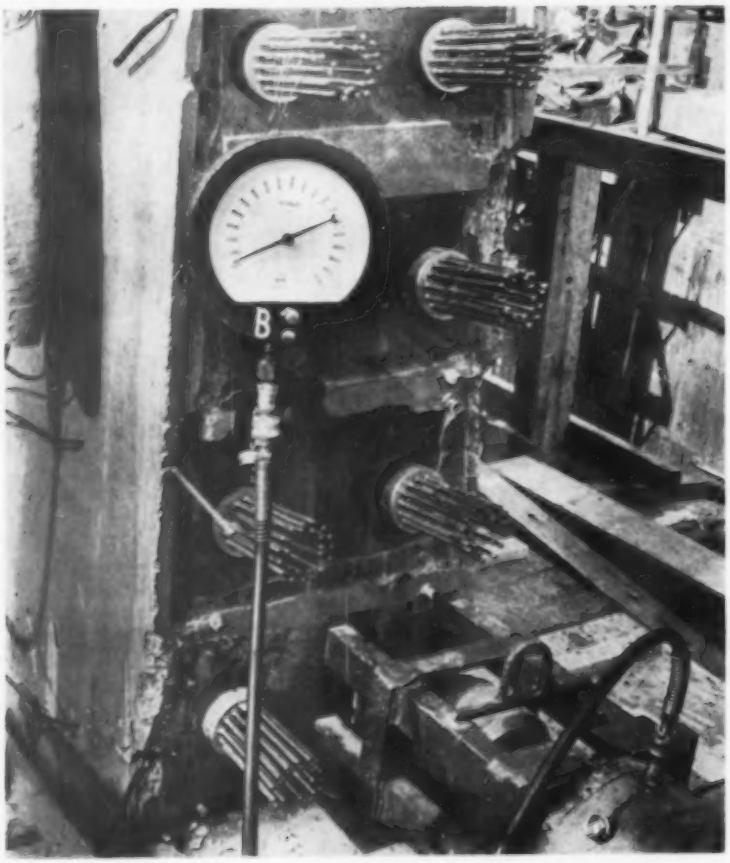
about fluid power

Hydraulic Cylinders Stress Girders

720 TONS OF CONCRETE went into the girders. The structure will support itself, the roof, and a hung balcony.



THE HYDRAULIC CYLINDERS grasp upset buttons at each end of the strands. For anchorage, a cone holds the second upsets.



Cylinders have set up a gigantic tic-tac-toe board in Utica, N. Y. It's the foundation for a new art gallery. Two rows of seven, hollow, flexible steel conduits were draped into the forms, and anchored to steel end plates. After the concrete had set, 25, ¼"-steel, post tensioning wires were put into each conduit. Then the cylinders went to work. For the next 2½ weeks, they stressed the tendons. Each tendon was required to maintain a final load of 175 kips. To compensate for creep in the steel, 206 kips were put into each tendon. To overcome friction during tensioning, the cylinders applied 218 kips. Half the stress was applied to each end. Each tendon was pulled about 8½". The stressing added ½" of camber to the girders, and shortened them ⅛" at each end.

The structure is being built by the George A. Fuller Co., New York City. ▼▼▼

Conference Covers Commercial Uses of Space-Age Design

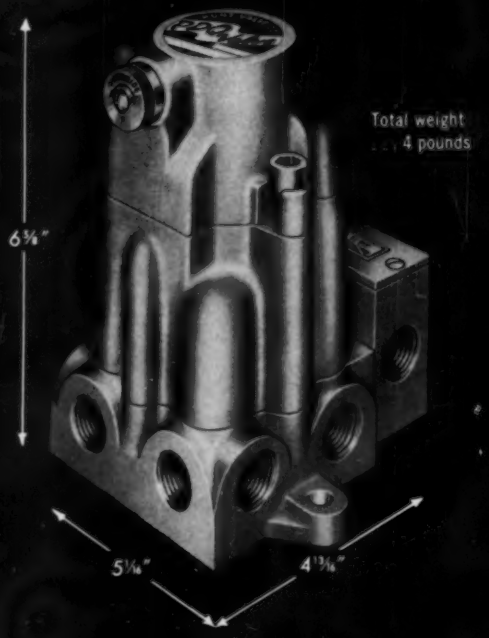
The use of space-age design in manufacturing commercial products will be the subject of the Design Engineering Conference, to be held May 23-26, at the New York Coliseum. The sponsor, the machine design division of ASME, expects a turnout of 20,000 engineers and executives. At the concurrent Design Engineering Show, over 400 companies will exhibit,

Continued on page 28

Circle 78 →

THE HUNT PDQ

has Faster Response Time and Greater Capacity than Air Valves—*4 Times Its Weight and Twice Its Size!*



You asked for a light, compact valve

Here is a full 1/2" air valve at **4 pounds.** It will flow 335 c.f.m. with 100 p.s.i.g. initial pressure to atmosphere. It measures 6-1/2" high by 5-1/16" wide by 4-13/16" deep.

You asked for speed and capacity

Here is what the Hunt PDQ is capable of. Response time to fill a 140 cubic inch vessel to 90 p.s.i.g. with an initial pressure source of 100 p.s.i.g. is .113 seconds. (6.8 electrical cycles.) To exhaust the same vessel from 90 to 10 p.s.i.g. is .195 seconds. (11.7 electrical cycles.)

The short-stroke pilot actuates a compact, full-orifice poppet-spindle amazingly fast . . . renders traditional air valves obsolete.

The Hunt 1/2" PDQ air valve is designed to do the things you've wanted a valve to do since the advent of automation. Write us today.

N. C. Hunt

N. C. HUNT, PRESIDENT

HUNT VALVE COMPANY · SALEM, OHIO, U. S. A.

- ☑ Accessibility
- ☑ Simplicity
- ☑ Speed and Capacity
- ☐ Price and Quality

The Hunt PDQ valve tops them all in every class.

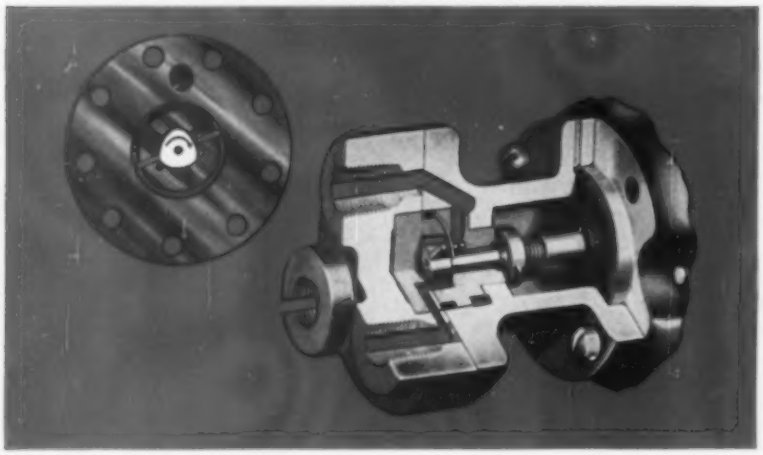
Next month . . .
the PRICE and QUALITY story.

HUNT HVC ***Quick-As-Wink*** AIR & HYDRAULIC CONTROL VALVES

YESTERDAY'S PIONEER . . . TODAY'S LEADER

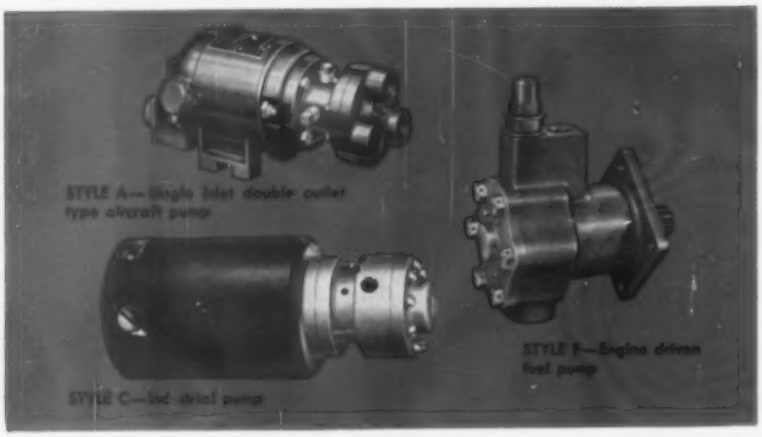
WELDON / FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.



COMPACT • LIGHT WEIGHT

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

OVER 40 YEARS OF LEADERSHIP SINCE 1918

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD · · · CLEVELAND 4, OHIO

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BRIEFS

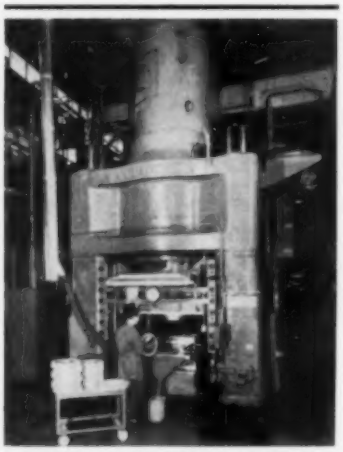
and about 4000 experts will answer visitors' questions.

The first session will be a panel discussion by design authorities in nuclear and space technology. They will tell how new design principles and formulas of their fields can apply to commercial products.

Sessions on power and control will consider "Reliability Predictions," "Impact of Reliability on Design," and "Analysis of Control Systems." Subjects of materials papers will be "New Welding Processes," "Metal Part Fabrication by Explosives," "Some Characteristics of High Strength Steels," and "Composite Materials." Mechanics sessions will cover "Hydraulic Components for Extreme Service," "Fluids and Seals for Extreme Service." "Modular Dimensioning for Automatic Assembly," and "Basic Design Parameters for Automatic Assembly." A panel session will consider "Use of Computers in Design."

For information, hotel reservations, or rapid registration cards, write Clapp & Poliak, Inc., 341 Madison Ave., New York, 17, N.Y.

▼▼▼



POWDER BRIQUETTING PRESS presses metal powders into compact wafers for large clutch plates. Used for briquetting powdered metals for sintered metal friction material assemblies, it has a rated capacity of 8,000,000 lb. squeeze. The machine is installed in the Wabash Division, Raybestos-Manhattan Corp.

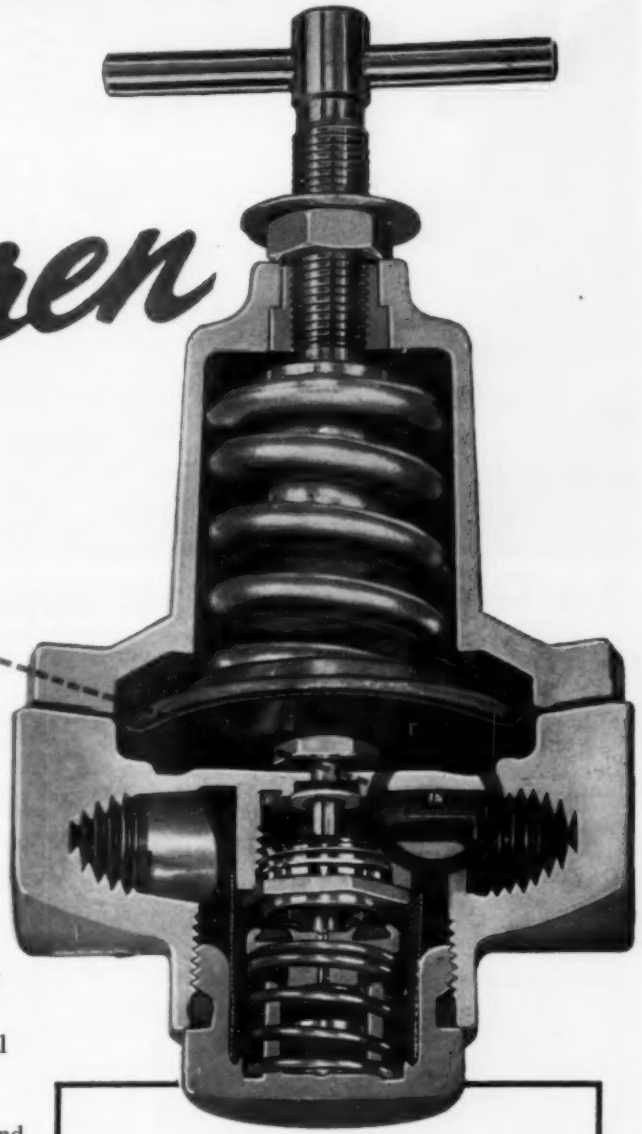
Continued on page 30

All Pressure Regulators are not alike

Norgren

Baffle and Siphon Tube Construction

provides more uniform regulated pressure as flow demand changes



In the ideal pressure regulator there would be no change in the regulated pressure no matter how wide the variations in the flow rate.

Norgren Pressure Regulators approach this ideal by providing a baffle and siphon tube feature. This increases the sensitivity of the valve to changes in the flow rate through the regulator and provides better performance and a more uniform regulated pressure over a wide range of flow rates.

The baffle protects the diaphragm from pressure shock and abrasive action. This gives you longer regulator life, more dependable operation and minimum maintenance.

For complete information on all your regulator needs, ⅛" to 2", call your nearby Norgren Representative listed in your telephone directory - or WRITE FACTORY FOR DESCRIPTIVE LITERATURE.

Norgren Pressure Regulators give you these important features:

- Balanced Valve Construction — improved regulator performance
- Large Nylon-reinforced Buna N Synthetic Rubber Diaphragm — long service life
- Baffle Plate and Siphon Tube — increased accuracy
- Large Passages and Valve Openings — large flow capacity
- Easy servicing while still on air line
- Flexible Valve Pin — assures better seating

FOUNDED IN 1926

C. A. NORGREN CO.

3402 SOUTH ELATI STREET • ENGLEWOOD, COLORADO

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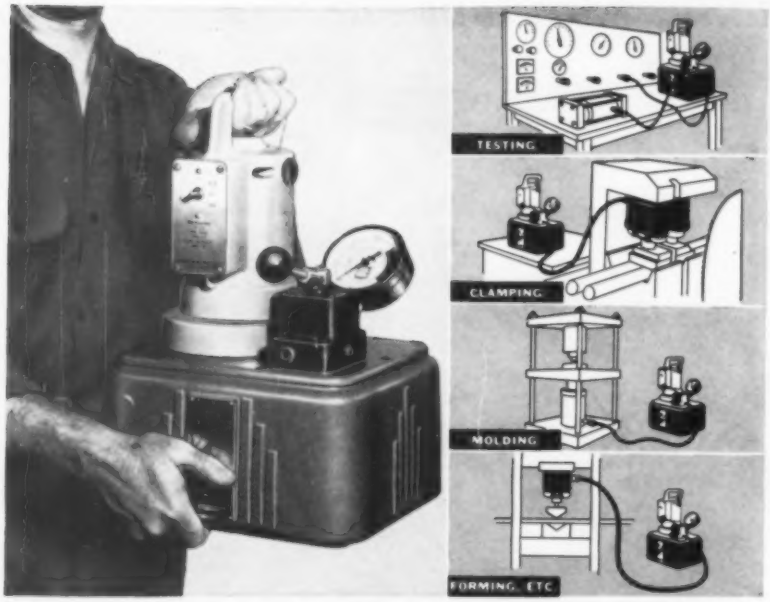
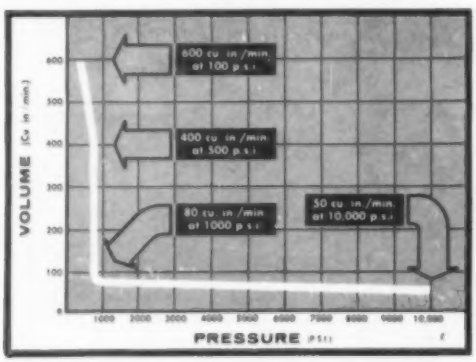


3½ Times Faster ram approach and return!—with new two-stage hi-pressure hydraulic pump!

- **DELIVERS FROM 2.6 GPM @ 100 PSI, 1.75 GPM @ 500 PSI, 80 CU.IN./MIN. @ 1000 PSI TO 50 CU.IN./MIN. @ 10,000 PSI!**
- **COMPACT: WEIGHS ONLY 45 LBS.; ONLY 17½" HIGH!**

Imagine the time you can save! . . . when your rams move to and from work 3½ times faster! . . . and up to 7 times faster between 150 and 500 PSI! That's what you save with the new OTC "Vanguard" complete pumping unit, as compared to any other single two-stage, hi-pressure unit of comparable size.



All wearing parts are made of finest tool steel, heat-treated and ground and lapped to assure efficiency and long life.

A variety of valves, controls and accessories are available.

Here is a new and revolutionary product! Your interest in reading this far is well founded.

For complete information, contact your OTC distributor . . . or write:

PRECISION HYDRAULICS DIVISION

OWATONNA TOOL COMPANY

710 CEDAR STREET **OWATONNA, MINNESOTA**

RESEARCH · ENGINEERING · DEVELOPMENT

OTC

Designers and manufacturers of the world's most complete line of Maintenance Tools and Hydraulic Equipment.

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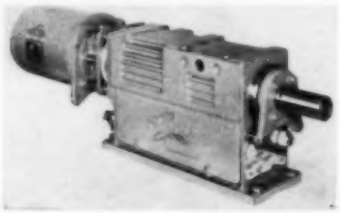
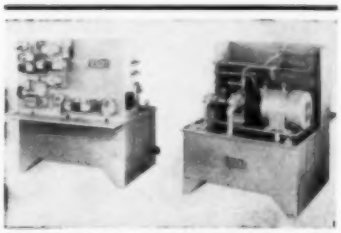
BRIEFS

Air-Oil Cylinder Powers Drill Head

To get smooth, positive, drill advance, this unit uses a compressed air cylinder to force fluid from a hydraulic cylinder. It can be adjusted for advance speed, feed



length, feed rate, and total stroke length. Made by The Hartford Special Machinery Co., Hartford, Conn., the unit can be used with any standard, building block components. The air and hydraulic cylinders are in-line to prevent shaft deflection, and valves can be serviced without disassembling the entire unit. ▼▼▼



TWO DRILLED MANIFOLDS simplify piping in this hydraulic power unit. It was designed and built for Wickes Crankshaft Lathe by the Hydraulic Div., J. N. Fauver Co., Inc., Detroit, Mich. The hi-lo circuits provide fast traverse with the large pump, and fine speeds with the small pump. A thermostatically-controlled heater prevents feed-rate changes. Temperature is kept between 100 and 120 F.

Hydraulic System Cools Engines

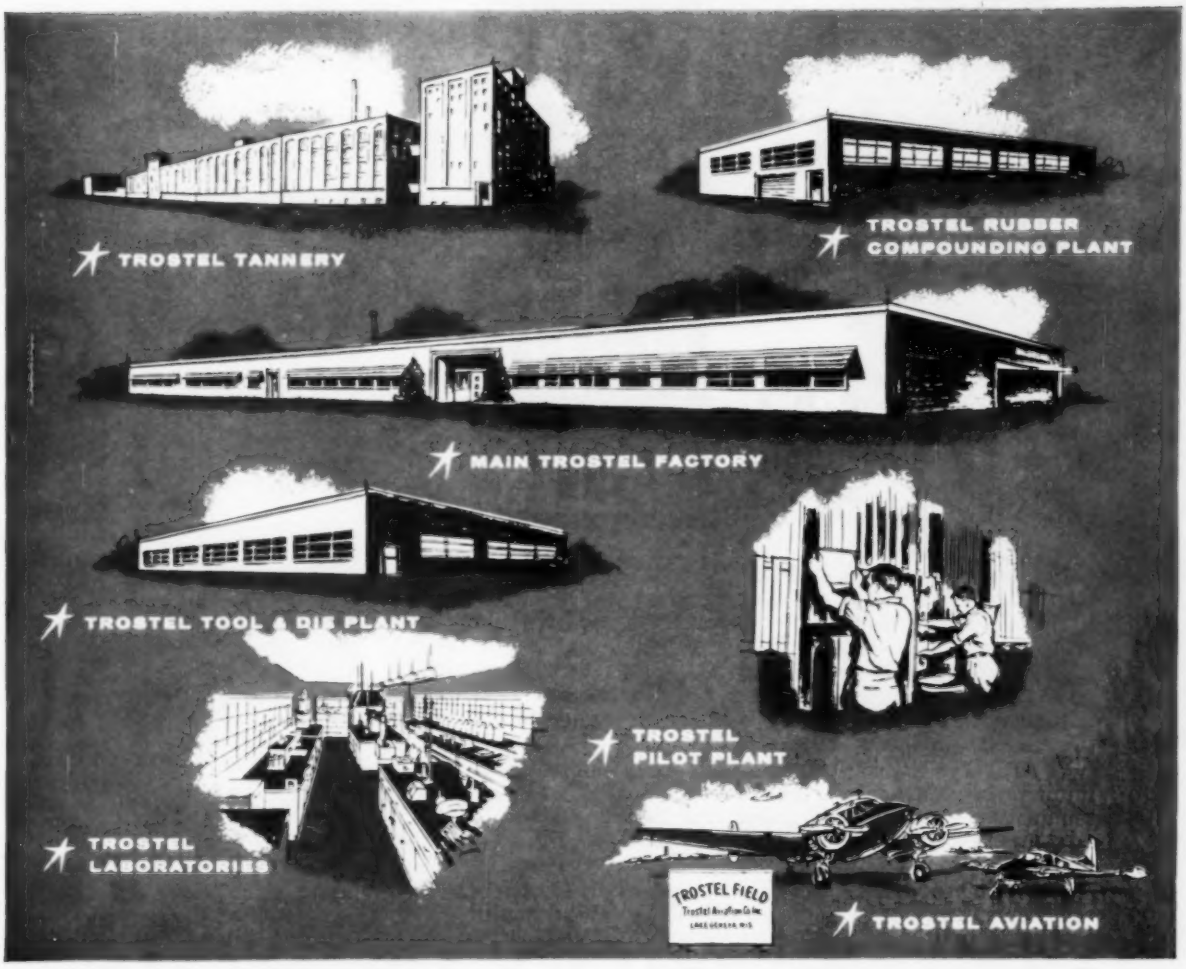
An unusual application of hydrostatic power transmission has been developed by Serck Radiators Ltd., Birmingham, England. In the Serck-Behr automatic fan control system, a hydraulic motor drives the cooling fan. Fluid from the

Continued on page 32

TROSTEL

A complete producing organization for

☆OIL SEALS ☆PACKINGS ☆O-RINGS



Quality in every phase of supply and manufacture is assured through Trostel ownership of all essential facilities

From raw materials to finished product, all key sources of supply and manufacture are Trostel owned and operated. Leather is tanned at the Trostel Tannery. Rubber is compounded at the Trostel Compounding Plant. Dies are made at the Trostel Tool and Die Works. Three separate Trostel Laboratories conduct research in leather, impregnations, and synthetics. A pilot plant tests all production runs. When, therefore, parts and materials arrive at the point of manufacture into seals and packings they are uniformly standard in specifications. Manufacture itself is by automatic machinery in a modern plant, with a quality control system that insures close-tolerance accuracy in all operations. Special delivery and service are provided by Trostel Aviation . . . we can come to you quickly, or bring you to us.

Trostel control of its products from raw materials to delivery is your guarantee of dependably high quality at all times, on every order. For catalog and technical data, write Albert Trostel Packings, Ltd., 700 Madison St., Lake Geneva, Wis.

TROSTEL QUALITY SINCE 1858

PACKINGS
OIL-SEALS
O-RINGS

Circle 145 on Time-Saver Card

EXTRA SAFETY EXTRA SERVICE

fulflo VALVES

ALL STEEL
for *positive* AUTOMATIC PRESSURE CONTROL

The combination of FULFLO Valve design with ALL-STEEL construction is outstanding when you're looking for safe, trouble-free and quiet operation in any hydraulic system.

FULFLO design offers shear-closing action to eliminate chattering; sliding piston for full flow opening; easy adjustment within the pressure range or change of the pressure range.

ALL-STEEL construction adds extra safety, maximum protection against fire or mechanical damage demanded by hydraulic designers and users . . . to the advantages proved by literally thousands of FULFLO all-brass or stainless trimmed valves.

Whatever your requirements . . . for O.E.M. use or replacement service . . . there's a FULFLO Valve designed just right, built right and priced right.

- **Screw or flange models . . . to 500 lbs. . . . pipe sizes to 3"**
- **Steel, cast or brass bodies . . . brass, steel or stainless trim**
- **Just 6 springs for complete range of pressures**
- **Fast shipment of standards . . . specials to your requirements**

Need a "special"?
FULFLO can engineer a special valve to your most exacting specifications . . . and deliver faster than you may think possible.

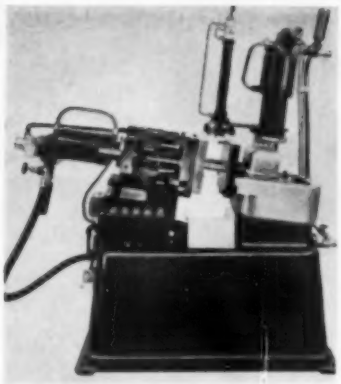
FOR COMPLETE INFORMATION,
request a copy of 1960 FULFLO Valves Mechanical Data Book.

FULFLO THE FULFLO SPECIALTIES CO., INC.
415 Fancy Avenue Blanchester, Ohio

Circle **57** on Time-Saver Card

BRIEFS

pump passes through a thermostatically-controlled, bypass valve. When radiator temperature is low, the valve passes pump output back to the tank, and the pump consumes little power. As the temperature rises, the valve closes the bypass circuit, admitting fluid to the motor. Thus, oil flow to the fan is proportional to the radiator temperature. Temperature variations are corrected by fan-speed variations. The system is particularly suited to the internal combustion engines of ships, railroad locomotives, and other heavy vehicles. ▼▼▼



SINGLE-CYCLE DIE CASTING MACHINE is push-button controlled. An electronic timer provides automatic operation. It has a solenoid valve system, with 2-way speed control for die setting and shockless operation. Exhaust mufflers quiet cycling. A sensing device retracts the toggles if foreign matter gets between the die faces. Valves and controls are outside the machine. Offered by DCMT Sales Corp., Div. British Industries Corp., Port Washington, N. Y.

Pneumatic Grinder Has Overspeed Safety Device

In pneumatic grinders, an overspeed safety device with an anti-defeat feature protects personnel from dangerous wheel speeds. If the governor fails, the device cuts off air to the motor. Air remains

Continued on page 38

For Cylinders, Circle **70** →
For Fittings & Hose, Circle **119** →

PARKER-HANNIFIN FLUID SYSTEM COMPONENTS

Hannifin high-pressure hydraulic cylinders feature a drip-free rod gland with "LIPSEAL"® and "WIPERSEAL." This feature, plus straight-thread, O-ring-sealed ports, insures leak-proof cylinder installations.

Parker "Krimp-lok" permanent-end hose assemblies and "Hoze-lok"® reusable fittings can be ordered with O-ring-sealed straight threads to insure leak-proof hydraulic connections to 5,000 psi.

from **PARKER-HANNIFIN...**

straight-thread ports and fittings

for leak-proof

hydraulic systems

Both Parker "Triple-lok"® flare-type and "Ferulok"® flareless fittings include straight-thread shapes in steel and stainless steel for leak-free tube connections. Write for our handy "Fittings Finders" for quick selection of Parker tube fittings, hoses and hose fittings.

Parker straight-thread hydraulic fittings, mated with S.A.E. bosses (offered at *no extra charge* on Hannifin cylinders), guarantee leak-proof cylinder port connections.* This use-proved sealing method is J.I.C. recommended.

To insure leak-proof performance throughout your hydraulic systems, Parker offers both "Triple-lok" flare-type and "Ferulok" flareless fittings for leak-proof tube connections. Where you need high pressure, permanent-end hydraulic hose assemblies, Parker supplies "Krimp-lok." And for fast, leak-proof field service or replacement, Parker "Hoze-lok" fittings require no skiving of the hose, need a minimum of tools for assembly.

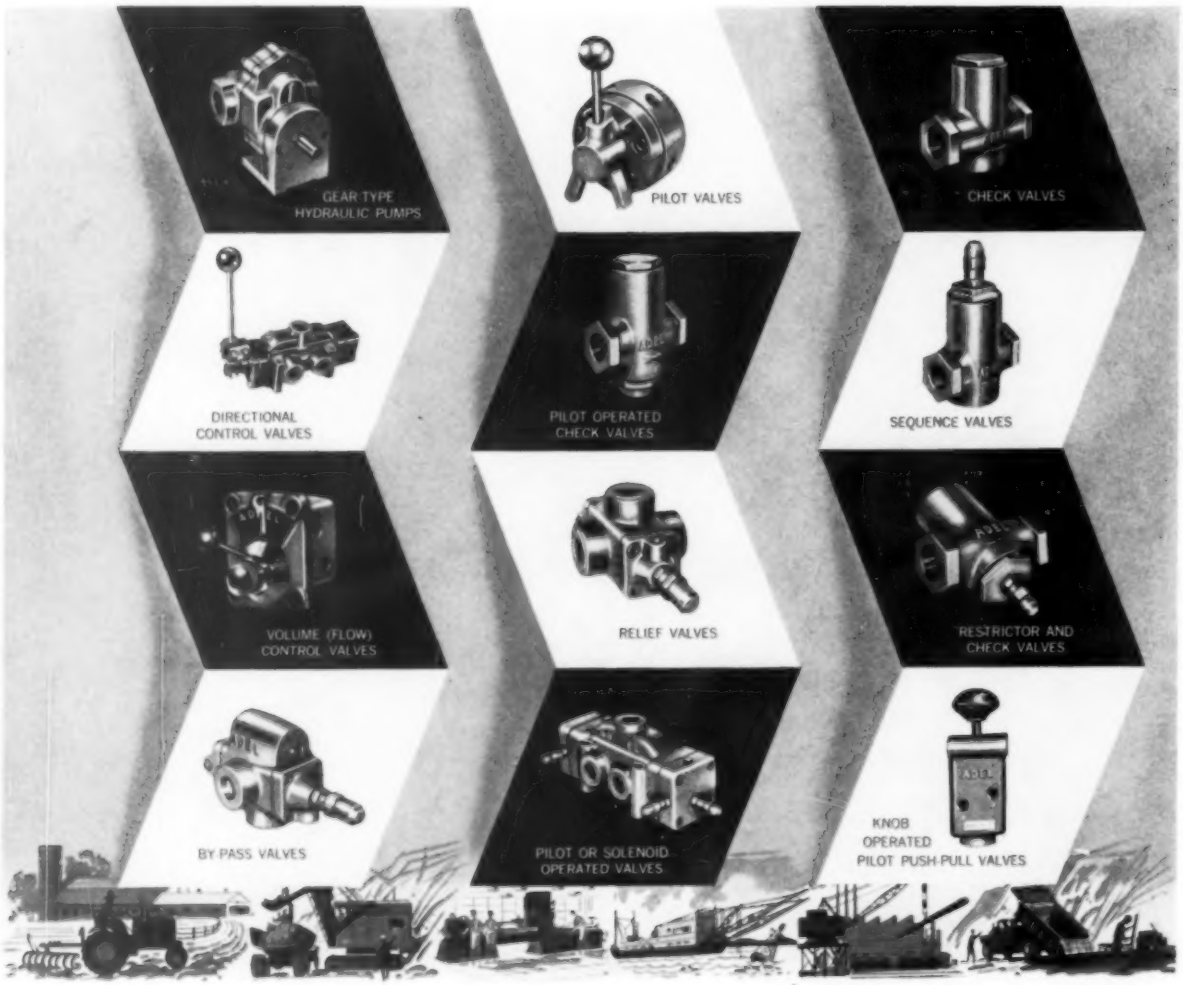
Your Parker-Hannifin man is qualified to help you with installation problems. He'll also help you plan your hydraulic layouts.

**Both Parker fittings and Hannifin cylinders are still available with "dry-seal" pipe threads.*

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

HANNIFIN COMPANY
545 S. Wolf Road, Des Plaines, Illinois

DIVISIONS OF PARKER-HANNIFIN CORPORATION



reliability ADEL PRECISION HYDRAULIC EQUIPMENT

....synonymous for fail-safe performance!

A complete line of valves and pumps for every application ADEL contributes cost-savings to the Original Equipment Manufacturers, not only in terms of initial cost, but in design features that provide preventive maintenance and, most important, *maximum operating efficiency over the years.* ■ If you need a hydraulic valve or pump replacement for your equipment... *specify* ADEL and you won't need another! ■ **You name the application...** ADEL has the Precision Hydraulic Equipment to meet your requirements. ■ *Write for complete engineering specifications.*

NEW DIMENSIONS IN reliability **ADEL** PRECISION PRODUCTS

Designers and Manufacturers of
INDUSTRIAL & MARINE
HYDRAULIC CONTROL EQUIPMENT

A DIVISION OF GENERAL METALS CORPORATION
1444 WASHINGTON AVENUE,
HUNTINGTON 4, WEST VIRGINIA
DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE U. S. AND CANADA

Circle 2 on Time-Saver Card

O-M PRECISION GIVES CYLINDERS GREATER EFFICIENCY and DEPENDABILITY

Meets JIC Standards **Fits Where Others Won't**

By machining to micrometer accuracy the working surfaces within O-M Air and Hydraulic Cylinders, these units function with high operational effectiveness and a minimum of routine maintenance.

More than this, O-M precision workmanship is reflected in every engineering and construction detail. These components are designed right to seal right. The ports are readily rotated independently to a desired location. Accurate machining assures perfect piston rod alignment on extreme in and out positions, on maximum or minimum loads as well as on short or long travel.

O-M standard, oversize and 2 to 1 rods have a high yield point that increases fatigue strength. The low coefficient of friction and cushion ball-check valve provide for full-power starts. End plugs are tapped for universal mounting.

Series 101A (illustrated) and Series TH (Heavy-duty Hydraulic Cylinder) are available in a complete range of sizes (1½" to 8" bores) and a full line of mounting brackets. Immediate delivery on many sizes.

Mail coupon at once for Bulletin 101A and 105 containing engineering data on the two units.

ORTMAN-MILLER MACHINE COMPANY
1 143rd Street, Hammond, Indiana

☐ Have representative call
☐ Send Bulletins 101A and 105

Name_____ Position_____
Company_____
Address_____
City_____ Zone____ State_____

PROTECT YOUR PNEUMATIC EQUIPMENT...

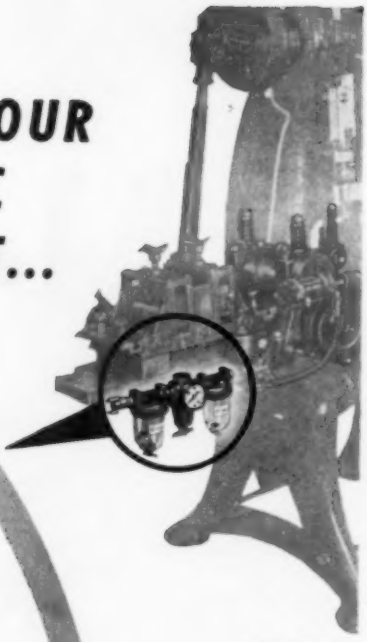


Photo courtesy F. J. LITTELL MACHINE CO.

the most Efficient and Complete

AUTOPNEUMATIC CONTROL by Arrow

Complete Conditioning and Control of Compressed Air Prolongs Service Life, Reduces Maintenance and Repair of Air-Powered Tools, Cylinders, Valves and Other Pneumatic Equipment.

1. The **ARROW FILTER**—Removes dirt, rust, pipe scale and 98% free moisture.
2. The **ARROW AUTOMATIC DRAIN TRAP**—Automatically ejects accumulated moisture to eliminate periodic manual servicing.
3. The **ARROW PRESSURE REGULATOR**—Choice of Relieving-Self Bleed or Non-Relieving Types. In Line Flow-Accurate Control.
4. The **ARROW LUBRICATOR**—Introduces a fine spray mist lubricant into air stream to thoroughly lubricate working parts of pneumatic equipment.

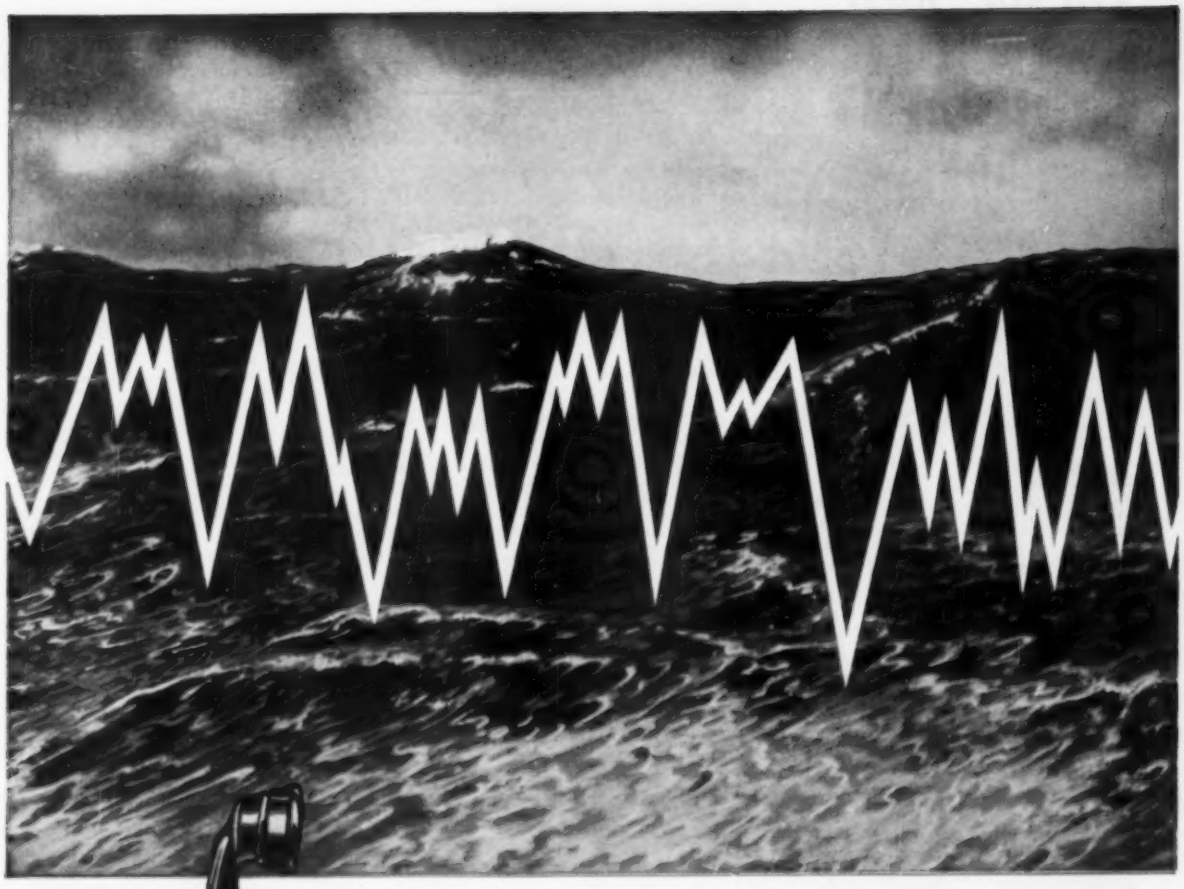
PIPE LINE SIZES: ¼"–⅜"–½"–¾" and 1" N.P.T.

New! Non-Shatter Bowls
Now Available

Catalog and Engineering Data Sent on Request

Arrow TOOLS, INC. 1934 S. KOSTNER AVE. CHICAGO 23, ILLINOIS

DEALERS IN ALL PRINCIPAL CITIES / CANADA—Higginson Equipment Sale, Ltd., Burlington, Ont.
EUROPE—Herion-Werke



Telecommunications

Two recent major steps in the improvement of world telecommunications have been the laying of the first Trans-Atlantic and the California–Hawaii submarine telephone cables.

When laying cable either on a flat sea bed or over underwater mountain ranges, the exact control of paying out speed and tension in the cable is of paramount importance. 'VSG' variable delivery oil hydraulic pumps are used to act as brakes on the cable, which is drawn out of the ship by its own weight. This enables a very smooth and regulated control to be maintained or instantly varied to suit ship speed, paying out speed and tension in the cable.

It is just another of the highly varied applications of 'VSG' variable delivery pumps and transmission gears which have now been serving modern industry for over fifty years.

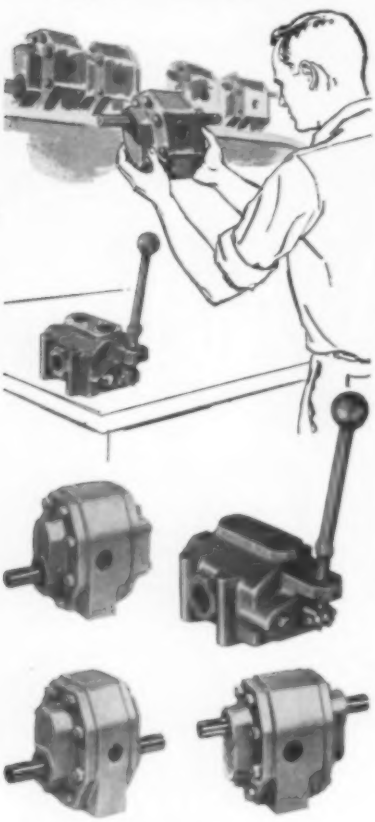
'VSG'

Regd Trade Mark

SERVING MODERN INDUSTRY

VICKERS ARMSTRONGS (ENGINEERS) LTD VICKERS HOUSE BROADWAY LONDON SW1

"Off the Shelf"
HYDRAULIC EQUIPMENT



in capacities from 8 to 25 gallons... up to 1000-1500 psi

Engineered by the world's largest manufacturer of hydraulic jacks, Hein-Werner pumps, motors and valves offer compact, high precision, light weight, balanced design. *Valves offer*: large oil passages, close grained high tensile body castings, spring centered ball detent hold, pressure relief valve and hardened seat INSERT for long life. *Motors and Pumps* feature forced lubrication and internal bleeding for axial balance and to eliminate high pressures against oil seals; rotation in either direction, heavy duty roller bearings and gear type constant displacement.

FOX RIVER MFG. CO.
A DIVISION OF
Hein-Werner CORPORATION
OSHKOSH 4, WISCONSIN

5014

Circle 73 on Time-Saver Card

BRIEFS

off until the device is reset. Removal of the throttle handle gives access to the governor and the device, which is independent of the governor. This provision guards against defeat of the safety device by keeping a grinder in service without restoring the governor to normal operation. Made by Thomas C. Wilson, Inc., Long Island City, N.Y., it is standard on all their grinders with rated speeds to 7200 rpm. It is not needed on grinders with higher rated speeds, because if their governors should fail, their free speeds are safely below wheel proof speeds. ▼▼▼

More Briefs on page 40

BRIEF NOTES

A SHORT COURSE ON FLUID POWER CONTROL . . . will be given at Massachusetts Institute of Technology, Cambridge, Mass., June 14-24. The two-week course will cover basic concepts and recent developments. It will emphasize high-pressure pneumatics; hot-gas control systems; reaction jet servomotors; and valve configurations, characteristics, and stability.

ASTE NOW ASTME . . . The American Society of Tool Engineers has changed its name to the American Society of Tool and Manufacturing Engineers. The new name covers members whose activities branch out into all fields of manufacturing.

NEW SHEET PACKING . . . has the chemical, ozone, and aging resistance of Hypalon synthetic rubber, and the strength, inertness, and economics of asbestos. Made by the Keasbey & Mattison Co., Ambler, Pa., the packing is not subject to cold flow under compression. Compressibility is about 20%; recovery, a minimum of 40%.

ROTATING AIR CYLINDERS & ADAPTERS . . . Revised American Standard B5.5-1959, has been approved by ASA, and published by ASME. The method for dimensioning radial hole locations conforms with the manual of American Standards for drafting. Changes permit lighter and shorter cylinders. Stroke length, rod position at end of stroke, rod diameter, and size of tapped hole in the rod have been changed, so that air cylinder draw rods need not be fitted to individual air cylinders.

BUSINESS BRIEFS

EARNINGS BETWEEN $2.40 AND $2.50 . . . per share are expected by Victor Equipment Co. for 1959. This would be a 20% increase over the 1958 figure of $2.01.

PUROLATOR GETS TWO USAF CONTRACTS . . . The Air Force has ordered 21,500 assemblies from Purolator Products, Inc., to replace elements in filters for jet fuels and aviation gasoline. Another order is for 100,000 hydraulic reservoir filter elements for aircraft systems. The orders will cost the Air Force $351,516.

MORE INDUSTRIAL BALL VALVES IN 1960 . . . Hydromatics, Inc., Livingston, N. J., expects industrial ball valve sales to hit $25 million in 1960. In fiscal 1958, industrial sales were $1 million; in 1959, $5 million, equalling military sales. Military sales will be about the same in 1960. Although there will be fewer units, valves will be larger.

KOEHRING CO. DOUBLES PROFITS . . . For the year ending November 30, 1959, the parent firm of Hydraulic Press Mfg. Co., Mt. Gilead, Ohio, netted $2,386,153 from sales of $60,937,700. This amounts to $1.37 per share. In 1958, sales of $45,457,585 generated profits of $1,165,266, amounting to 64c per share. $7,303,000 of the $15,480,115 sales increase came from companies acquired by Koehring in 1959. The remainder represents an 18% gain over 1958.

WEATHERHEAD

offers one source for all tube fitting needs... a complete line of flared, flareless or pipe...

TUBE FITTINGS of BRASS, CARBON or STAINLESS STEEL

BRASS FITTINGS

S.A.E. 45° FLARE
USED with copper, brass, aluminum, steel and plastic tubing. PRESSURE RATINGS up to 5000 p.s.i. **Sizes: ⅛" to ¾".** Also available in 37° heavy pattern brass. Listed by U.L.; approved by A.G.A. Meets specs of S.A.E. Hydraulic Tube Fittings Standards and A.S.A. and A.S.M.E. codes for instruments and control piping.

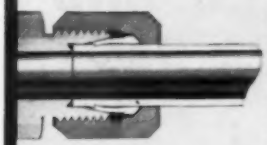
COMPRESSION
USED with copper, brass, aluminum and plastic tubing. PRESSURE RATINGS up to 2000 p.s.i. **Sizes: ⅛" to ¾".** Listed by U.L.; approved by A.G.A. Meets specs of S.A.E. Hydraulic Tube Fittings Standards and A.S.A. and A.S.M.E. codes for instruments and control piping.

SELF-ALIGN®
No flaring, soldering, welding—insert tube and tighten nut. USED with copper, brass, aluminum and plastic tubing. PRESSURE RATINGS up to 2000 p.s.i. **Sizes: ⅛" to ¾".**

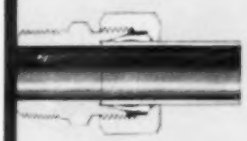
INVERTED FLARE
USED with copper, brass, aluminum, steel, Bundyweld and plastic tubing. PRESSURE RATINGS up to 3000 p.s.i. **Sizes: ⅛" to ¾".** Listed by U.L. Meets specs of S.A.E. Hydraulic Tube Fittings and A.S.A. and A.S.M.E. codes for instruments and control piping.

PIPE
USED with brass or steel pipe. PRESSURE RATING: up to 5000 p.s.i. **Sizes: to 2".** Meets specifications of S.A.E. TPHL Fittings Committee.

FORGED STEEL FITTINGS



"7000" SERIES ERMETO®
U.L. listed. Meets J.I.C. standards. S.A.E. approved "O" Ring boss design. Dryseal pipe thread. Needs no flaring. Available in either carbon or stainless steel. Carbon steel fittings have "Weathercoat" or cadmium-plate finish. PRESSURE RATINGS: up to 10,000 p.s.i. **Size Ranges—⅛" through 2".**

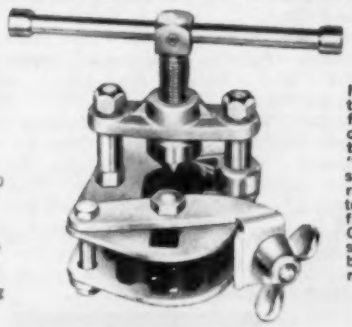


"8000" SERIES ERMETO®
Listed by U.L. for use with hazardous liquids, fuel equipment, refrigeration and gas; meets specs of S.A.E. and J.I.C. hydraulic tube fitting standards. Supplied as standard in cadmium-plated carbon steel and in stainless steel. Requires no flaring. PRESSURE RATINGS: up to 10,000 p.s.i. **Size Range—⅛" through 2".**

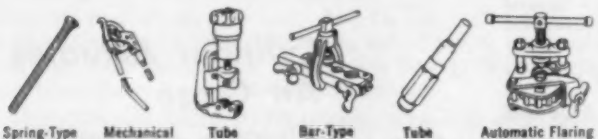
FLARE-TWIN—(2-pc. or 3-pc.)
37° FLARE STEEL TUBE FITTINGS
Listed by U.L. S.A.E. and J.I.C. approved. Used with J.I.C. and other soft steel tubing; also with copper, aluminum, and fully annealed stainless steel tubing. Meets S.A.E. standards for straight thread boss mounting. PRESSURE RATINGS up to 10,000 p.s.i. **Sizes: ⅛" through 2".**

FLARE-TWIN
Made in 3-piece and 2-piece assemblies. 2-piece type offers price advantage. "Weathercote" or cadmium-plate finish.

FAST! EASY! ACCURATE TUBE WORKING TOOLS



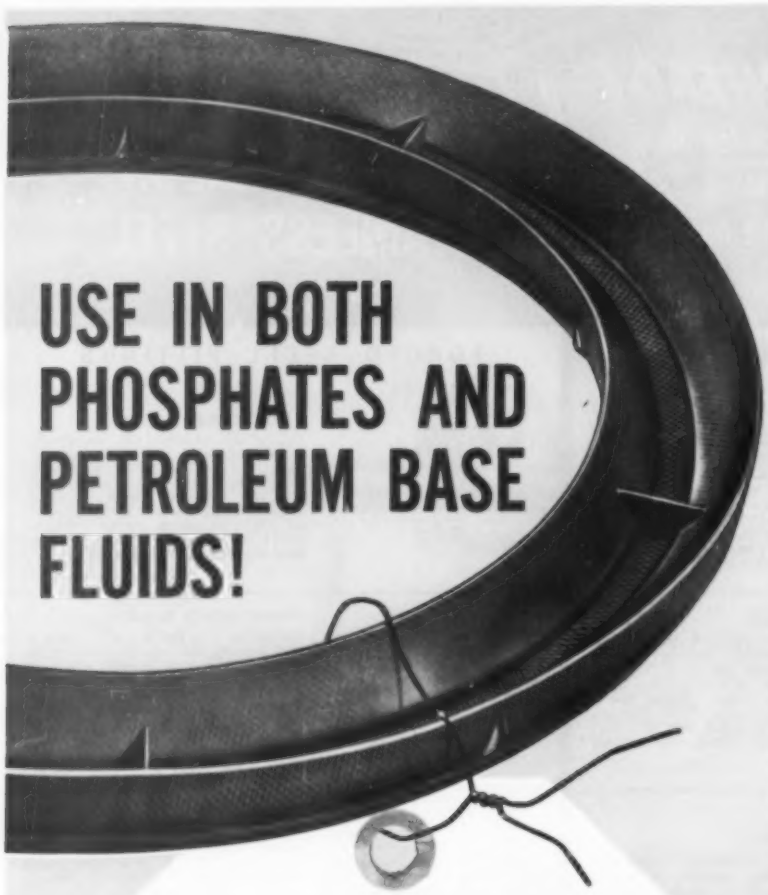
New rotary flaring tool for perfect tube flaring. Fast . . . one piece construction. Easier . . . "Dial - Matic" tube size selection. Accurate...tube stop automatically controls flaring diameter. Compact . . . easy to store. Available with burnishing attachment.



Spring-Type Bender | Mechanical Bender | Tube Cutter | Bar-Type Flaring | Tube Swaging | Automatic Flaring Rotary

THE WEATHERHEAD COMPANY

FORT WAYNE DIVISION • Dept. AH-3, 128 West Washington Blvd. Fort Wayne, Indiana



USE IN BOTH PHOSPHATES AND PETROLEUM BASE FLUIDS!

TECHNICAL MEMO ON LINEAR COMPOUNDS 8310-70 and 3283

. . . specially designed for O-Rings and V-Rings

- Versatile new elastomer material, homogeneous for O-rings . . . fabric reinforced for V-rings
- Highly resistant to a wide variety of fluids. Suitable for phosphate esters and petroleum base fluids, plus many other organic fluids
- Effective sealing in temperatures from −20° to +250°F.

FLUIDS COMPATIBLE WITH COMPOUNDS 8310-70 and 3283

Arochlor 1242 • Butyl Cellosolue • Cellulube • Cotton Seed Oil • Crude Oil • Cyclohexane • Dioctyl Adipate • Dioctyl Phthalate • Dow Therm A • Ethyl Formate • Fuel Oils • Gasoline • Glycerine • Hexane JP-4 • JP-5 • Larex • MIL-L-2105 • MIL-H-5606 MIL-L-6086 • MIL-L-7808 • MIL-L-7870 • MIL-L-15017 MIL-G-15793 • MIL-F-25558 • Mineral Oils • Monsanto OS-70 • Motor Oils • Olive Oil • Pydraul Pyranol • Shell #532 • Shell Tellus #33 • Skydrol SR-6 (40% Aromatics) • SR-10 (Non-Aromatics) Sunvis #7 • Tetrachloroethylene • Water

For detailed technical data—including a list of incompatible fluids—write today for Technical Bulletin 56702-1. Linear Inc., State Road and Levick St., Philadelphia 35, Pa.

PERFECTION IN RUBBER
LINEAR

Circle **93** on Time-Saver Card

BRIEFS

Philadelphia to Host ASME Fluid Power Meeting

"Unscrambling the Fire-Resistant Fluid Puzzle" will be the subject of the speech given at the March 29 meeting of the Philadelphia Division, ASME. Speaker will be John A. Mathe, chief application engineer, E.F. Houghton & Co. Place is the Engineers' Club, 1317 Spruce St. Dinnertime is 6:00. The meeting begins at 7:30.

▼▼▼

RIDER-WALKIE ELECTRIC LIFT TRUCK handles and stacks heavier loads in intermittent duty cycle operations. The Worksaver's tilt cylinders are mounted high, almost parallel to the floor, for maximum mechanical efficiency and faster tilting. A heavy-duty pump draws from an 1100-cu. in. reservoir. The 4000-lb. truck is made by Yale Materials Handling Div., Yale & Towne Mfg. Co., Philadelphia, Pa.

Cylinder Actuates Air Gage

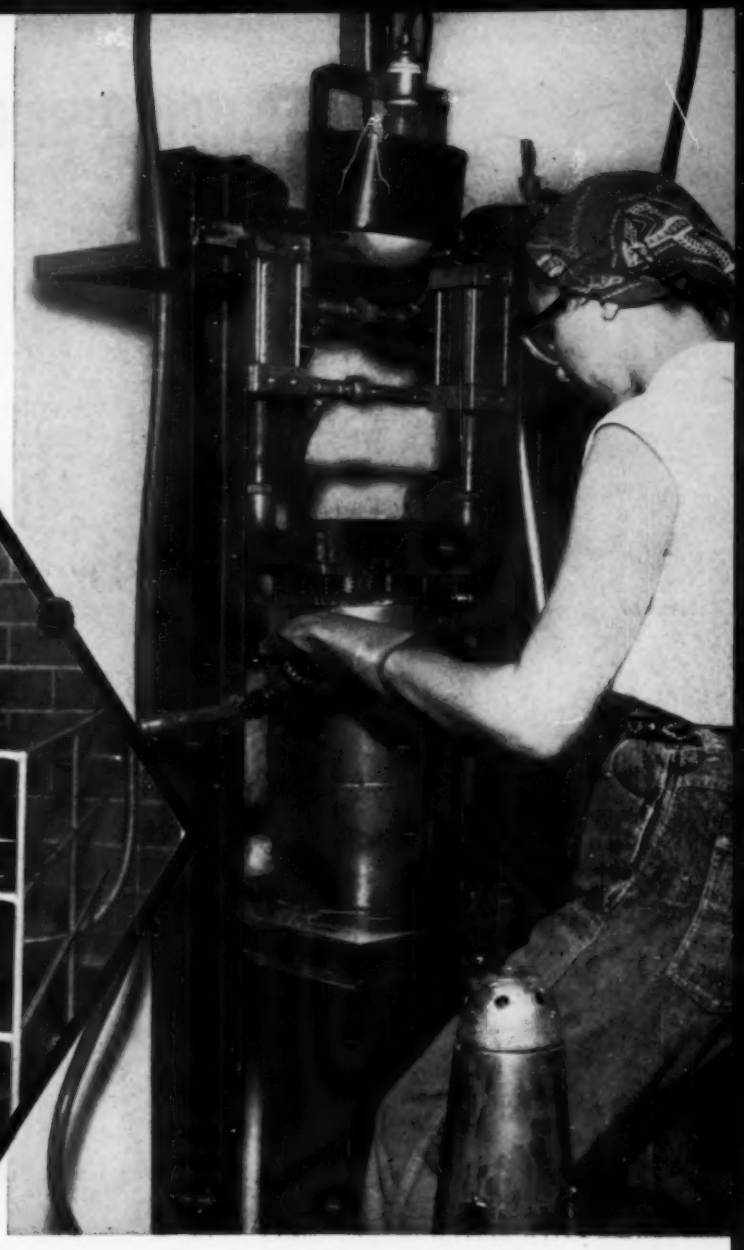
In-process gaging and thread rolling techniques make this six-station index machine versatile. The diameter on which the thread is rolled can't be too large or the dies will break. If the diameter is

Continued on page 42

Circle **91** on Time-Saver Card →

TEST MACHINE at a metal fabrication plant gets air from the Le Roi 100S2 shown below. Unit also supplies air for presses, automatic and manual welders, painting machines, and automatic assembly machines.

puts your plant air supply right where you need it!



LE ROI 100-HP STATIONARY COMPRESSOR

Trouble-free air-cooled LeRoi 100S2 delivers 450 cfm of air at 125 psi — yet takes up only 20 sq. ft. of floor space.

Any way you look at it, the Le Roi 100S2 two-stage stationary compressor is your best bet to lower your cost of compressed air.

It provides cool, clean airpower. And its compactness permits installation *near the point of use*, thus eliminating excess piping and costly waste of air. If you need more air, you just install more Le Roi S2 compressors — and you can still beat the cost of centralized air systems.

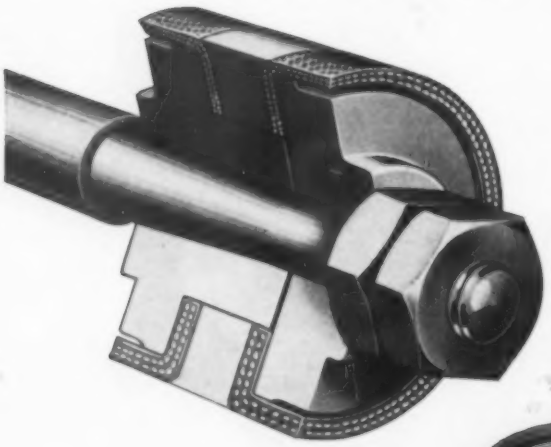
The electric-motor-driven 100S2 is easy to operate and maintain. Its Dual-Control permits either constant-speed or automatic start-and-stop operation. Air cooling eliminates plumbing and water line freeze-ups . . . permits indoor or outdoor installation. Balanced design reduces vibration and noise . . . extends compressor and motor life.

Put your compressed air system on a paying basis. Investigate the complete Le Roi line of unit-type and stationary air compressors — from ½ to 100 hp. Contact your Le Roi distributor, or write to Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wisconsin. SC-05

LE ROI STATIONARY COMPRESSORS

PORTABLE AND TRACTAIR® AIR COMPRESSORS • STATIONARY AIR COMPRESSORS • AIR TOOLS

LESS FLUID SLIPPAGE!
LESS DOWNTIME!
GREATER EFFICIENCY!



Darcova Pumcup

...in hydraulic and pneumatic mechanisms, reciprocating pumps

Darcova 45° Bevel Type Pumcup

THE BIG DIFFERENCE you'll find in Darcova Pumcups is that they operate at full efficiency *throughout their entire life.* This means fluid slippage is virtually eliminated.

And because fewer replacements are necessary, you have less downtime. Users report that Pumcups *outlast ordinary packings at least 3 to 1!*

Pumcups are available in three textures—hard, medium and soft. Also in regular or 100% nylon composition. Sizes range from ¾" to 20". For all the facts on Pumcups, write for Bulletin **5903.**

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

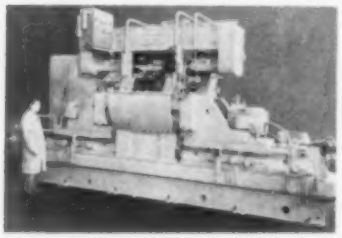
DARCOVA
THE ORIGINAL COMPOSITION CUP

TRADE MARK
PUMCUPS

Circle **45** on Time-Saver Card

BRIEFS

too small, a poor thread will be formed. Before the threads are rolled, hydraulic, cylinder-operated scissors mechanisms extend



air-snap gages to check the part diameter. If it is not correct, the machine shuts down.

Made by Snyder Corp., Detroit, Mich., the machine also has hydraulic tool feed and indexing. ▼▼▼

... AND INSTEAD OF PUTTING A VALVE IN THE LINE .....YOU JUST PULL BOTH ENDS!!

2nd Hydraulic Handbook is Available

The 800-page, second edition of the British HYDRAULIC HANDBOOK is available from Trade & Technical Press Ltd., Morden, Surrey, England. It explains hydraulic principles, components, and maintenance. Included are examples of hydraulics in agriculture, aircraft, mining, machine tools, presses, and railway, marine, materials handling, and mobile equipment. The technical data section contains diagrams, formulas, tables, charts, nomograms, and a

Continued on page 44

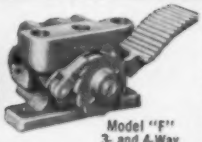
NOPAK®

Fluid Power Products

The Complete Line that Meets All of Your Needs

NOPAK
Rotating Disc
VALVES

3- and 4-Way Hand Valve



Model "F" 3- and 4-Way Foot Valve

2-, 3-, and 4-way, are used for hand or foot control of cylinders to 250 p.s.i., air or oil. Rotating disc covers metal-to-metal seal, shielding it from pressure flow or exhaust blast. This simple, rugged, packless construction (only 2 moving parts) has never been equalled for durability. Large variety of operating cycles obtainable. Model "F" shown provides unique 4-way cycle: reverses flow through valve on each pedal downstroke only.

NOPAK-MATIC
Poppet-Type
Pilot-Operated
VALVES

SERIES 310 2- or 3-Way

SERIES 420 4-Way

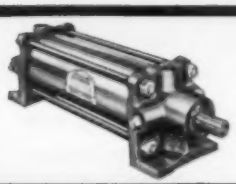
These fast acting, high volume air valves available in ¼" to 1¼" pipe sizes with master (air piloted), single or double solenoid. Mounting choice: side or bottom ported subplates or manifolds. No valve seats or piston bores machined into valve body. Removing end cover plates gives easy access to air actuated (no springs) piston poppets housed within removable, interchangeable cartridges. No disturbance of piping, wiring or mounting. 100% J.I.C. Standard valves operate as low as 10 p.s.i. Easily modified for vacuum operation.

NOPAK
FLOTROL®
Speed Control
VALVES

FLOTROL Model 20V

Variable Orifice Type capitalizing on the advantages of protected seat, pressure sealing and precision throttling inherent in rotary valve design — this flow control valve incorporates a bronze disc with crescent shaped port rotating over an aluminum body seat to which it is precision lapped. Desired orifice opening is obtained by external rotation of adjusting sleeve, subsequently locked in place by a set screw; 180 degree rotation full open to close. "In line" flow construction results in maximum volume, no restrictions through adjusting needles.

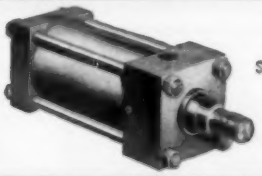
NOPAK
Class 1, 2 and M*
CYLINDERS



Model A Class 1 & 2 NOPAK Cylinder

Brass Tubing — Tie-Rod Cylinders with semi-steel cast heads for air, oil, or water service. Diameters from 1½" to 16", suitable for 250 p.s.i. Large selection from Shelf-Stock. Class 2 Cylinders have cylinder wall recessed into cylinder head, sealed by fibre gaskets. Class 2 recommended for air, oil, or water at pressures to 500 p.s.i. During the past 20 years they have earned a reputation as "The most cylinder for the least money."

NOPAK
Class 3 Square
Head CYLINDERS



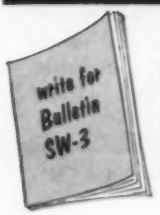
Square Head Cylinder

For Hydraulic service at pressures to 3000 p.s.i. Compact steel plate, square head, and tie-rod construction. Honed steel tubing. Heads adjustable cushioned or non-cushioned. 18 standard mountings. Interchangeable with other well-known square head hydraulic cylinders.

NOPAK
Class 4 Hydraulic
CYLINDERS

Model E Class 4 cylinder

These high-pressure hydraulic cylinders are fabricated from heavy, honed steel tubing with lock-ring flange construction which permits head rotation for most convenient mounting. No tie-rods! Built for hydraulic service to 4000 p.s.i. Choice of cushioned or non-cushioned heads; 5 standard mounting styles.



Bulletin SW-3 gives you a condensed summary of the Complete NOPAK Line. If you do not have a copy, write for Bulletin SW-3 — and address of nearest NOPAK representative — on your company letterhead, please.

* Class M Cylinders (Mill Type) have welded flange construction with honed steel tubing. No tie-rods. For all types of Heavy-Duty service at air or hydraulic pressures up to 750 p.s.i.

NOPAK ***VALVES and CYLINDERS***

GALLAND-HENNING NOPAK DIVISION
2743 S. 31st STREET • MILWAUKEE 46, WIS.

A3-647

HYDRO-JECTOR

AUTOMATICALLY DRAINS ANY FILTER, DRAIN LEG OR SURGE TANK

- GUARANTEED minimum 1 year trouble-free operation
- ½ internal discharge port
- Connecting Nipple available in 3 sizes
- Discharges at rate greater than 300 gallons of water per hour at 125 PSI
- Drains oil as well as water
- Transparent *Visi-Bowl* permits visual inspection
- Operates on pulsating, continuous or no flow
- No air loss during dump cycle
- Vent Nipple prevents air lock
- Manual Plunger permits "clean-out" without disassembly

The *M/P Hydro-Jector* can be installed easily and quickly in the bottom drain port of *any* compressed air filter, separator, drain leg, water bottle, surge tank, air receiver tank or other water collecting vessel.

This is not an ordinary float operated trap. The *Hydro-Jector* incorporates unique pilot valving and large internal discharge passages.

Only M/P offers a one year guarantee against clogging.

WRITE TODAY FOR COMPLETE INFORMATION

NEW AIR CYLINDER LUBRICATOR
For application in the *M/P Down-Stream Circuit*—a new M/P concept which assures reliable lubrication of even the smallest air cylinders.

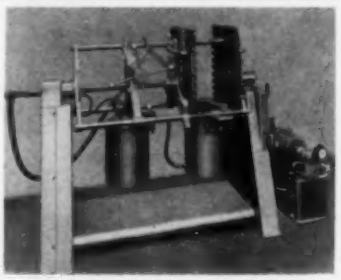
SHATTER-GUARD
A new feature which makes the *M/P Visi-Bowl* as safe as a metal bowl. Available on all M/P Filters, Lubricators and Hydro-Jectors.

MASTER PNEUMATIC, INC.
20430 SHERWOOD • DETROIT 34, MICHIGAN • Phone: TWinbrook 3-7070

Circle **103** on Time-Saver Card

BRIEFS

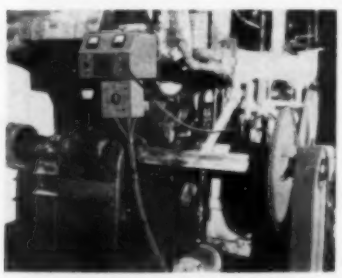
hydraulic dictionary. The buyers' guide has a trade names index, a classified list of hydraulic equipment and manufacturers, and an alphabetical list of principal British manufacturers. Price is $15.65, post free. ▼▼▼



THIS SHELL CORE MACHINE is hydraulically powered for fast, semi-automatic production of the largest cores. The production cycle takes less than a minute. The low-pressure power unit can be beside or away from the machine. Speed is adjustable. Made by Dependable Shell Core Machines, Inc., Portland, Oregon.

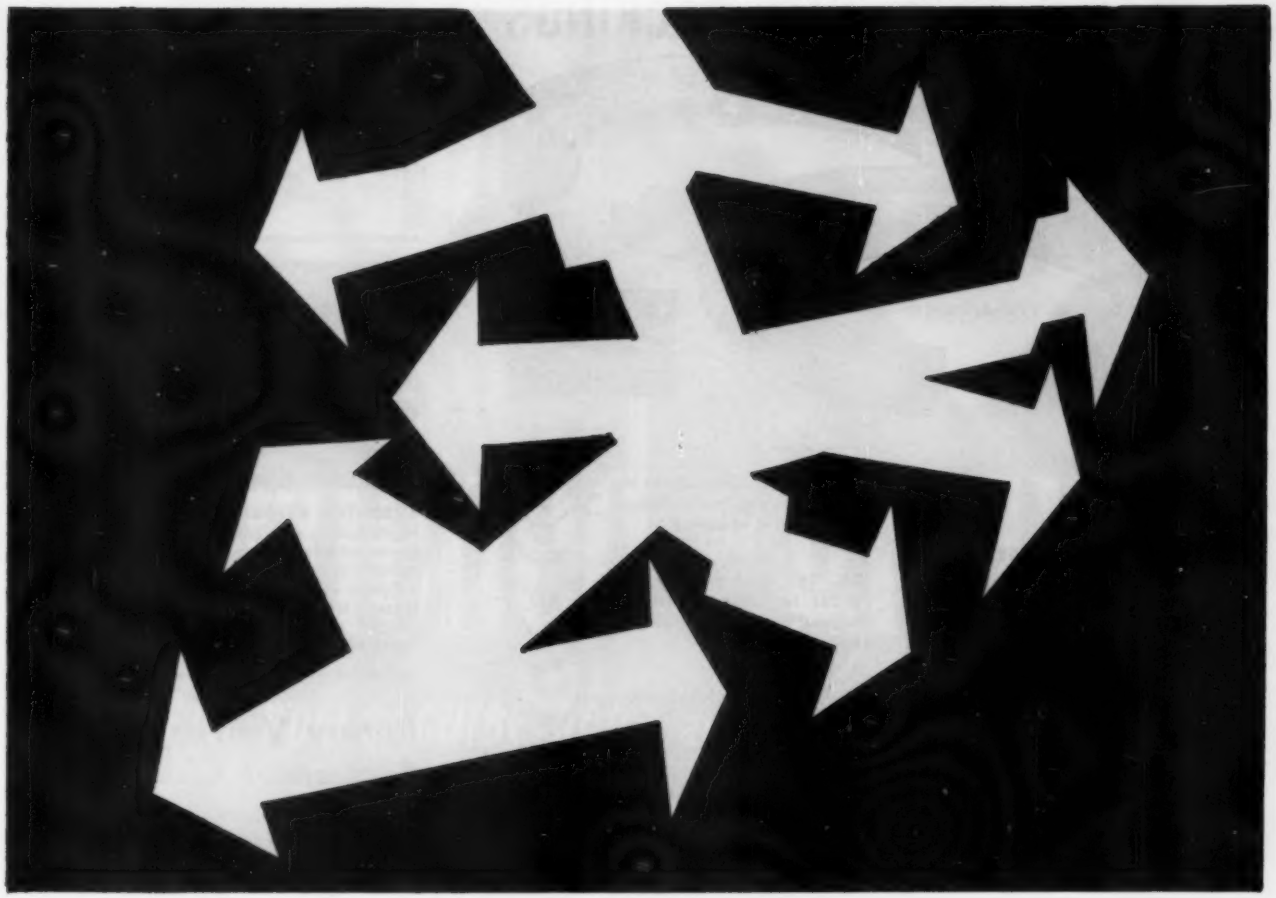
Hydraulics Drives Web Tension Control Unit

Two years ago, an automatic tension clutch replaced a link leather, slip-belt rewind drive on a waxing machine. To date, it has



required no maintenance. Oil produces torque, cools the system through recirculation, and lubricates. A push-button, automatic control box simplifies adjustments, and assures perfect uniformity of tensions. Web Control Corp. installed the unit for Fabri-

Continued on page 46



DIRECTIONAL CONTROL absolute control

of movement in any direction can

only be achieved by hydraulic power.

Ask us at KEELAVITE

We at Keelavite are a team of experts engaged SOLELY in the application of hydraulic power

KEELAVITE
Hydraulics

KEELAVITE HYDRAULICS LTD • ALLESLEY • COVENTRY • ENGLAND • TEL. MERIDEN 441

DESIGN ESSENTIALS FOR BETTER HYDRAULIC PACKINGS

THESE BASIC FEATURES are part of every "John Crane" Hydraulic Packing. They assure packings that meet the most rigid requirements of hydraulic service ...a good initial seal, long life, efficient performance over wide pressure ranges and stability in the fluid medium.

1. Pressure access allows immediate pressure distribution and packing response.

2. Ball joint nesting surfaces facilitate breathing without pinching, wedging or lip collapse.

3. Adequate lubrication reservoir.

4. Uniform bottom thickness eliminates weak points and insures centerline hinge action.

5. Molded-in lip interference insures tight static seal and conformation to bore and rod deflections.

6. Heel clearance prevents "riding" at heel and eliminates lip toe-in.

7. The fabric in the "V" rings is so laid to assure maximum strength—an important consideration for maximum packing life.

Tell us about your standard requirements and ask for recommendations and/or assistance in the creation of a combination of packings that will best handle individual operating conditions. Request Bulletin P-333 for general information.

Crane Packing Company, 6405 Oakton Street, Morton Grove, Ill. (Chicago Suburb).

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

John Crane

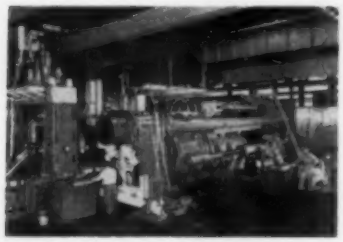
MECHANICAL PACKINGS · SHAFT SEALS · TEFLON PRODUCTS · LAPPING MACHINES · THREAD COMPOUNDS

CRANE PACKING COMPANY

Circle **42** on Time-Saver Card

BRIEFS

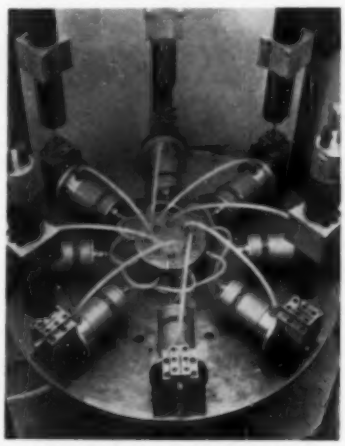
con Products, Philadelphia. It rewinds 1200-lb. rolls of paper 8½" to 32" in diameter. Web speeds ranges from 400 to 1000 ft/min. ▼▼▼



14,000-TON EXTRUSION PRESS is now in production at Alcoa's Lafayette works. It can extrude single pieces of aluminum in extreme lengths with widths to 39", weighing as much as 2500 lb. Previously, these were available only on Alcoa's original press operated under the Air Force Heavy Press Program.

Rotary Valve Sequences Clamps

This multi-station, rotary transfer machine drills 7 holes on 3/16 in. centers, in 7½ seconds. Speed is controlled by a variable orifice of a hydraulic dashpot, and by a



pneumatic flow restrictor. A special rotary valve sequences the release and clamping of the components at the fixtures. Built by Centec Machine Tools Ltd. of Hemel Hemstead, England, the machine table can be indexed at any angle up to 180 degrees. ▼▼▼

Circle **141** →

WEAR RESISTANT
THOMSON

60 Case

AVOID the HIGH COST and difficulty of fabricating long, hard & straight parts by conventional methods!

hardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

ELIMINATE WEAR and REDUCE COST

60 Case is the result of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining. *Write for literature and name of your local representative.*

For emergency needs call collect
MAnhasset 7-1800

ADVANTAGES of *60 Case*

- COST REDUCTION
- HARD BEARING SURFACE
- NICK-& DENT-PROOF
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

TYPICAL *60 Case* PARTS

GUIDE RODS • SHAFTING • ROLLS • TRAVERSE RAILS
PISTON RODS • ARBORS • LEADER PINS • TIE RODS
KING PINS • AXLES • CONTROL RODS • GUIDE POSTS
MANDRELS • BEARING ROLLERS • SPINDLES

THOMSON INDUSTRIES Inc.
Dept. C-4, Manhasset, New York

PARTS HARDENED to 60 C...
increase life...reduce cost!

STEEL LINES FOLD LIKE AN ACCORDION
Typical of diverse swivel joint applications, newly designed Chiksan Discpak joints are installed on the steam lines of a platen press. This new type swivel joint, designed for hot gas and steam, allows inexpensive packing replacement without removing swivel joint from line.

WHEN *design*
DICTATES
METAL LINES . . .

SOLVE LINE FLEXING PROBLEMS

with CHIKSAN SWIVEL

Chiksan swivel joints allow metal lines to be flexed in predetermined travel arcs, eliminate hose rupture, reduce maintenance and replacement costs.

Where tight bends in pressure hose make wide loops necessary, Chiksan swivel joints, conversely, permit compact placement of lines. When used with hose, Chiksan swivel joints shorten hose lengths and also lengthen hose life by minimizing tight bend and torsional fatigue.

Chiksan swivel joints are available from stock in a wide range of materials, temperatures, and pressures to meet practically every design requirement. Chiksan swivel joint packing units are designed for specific services. For example, packings have been developed to efficiently handle non-inflammable hydraulic fluids. **Write today for catalog** and name of nearby sales engineer.

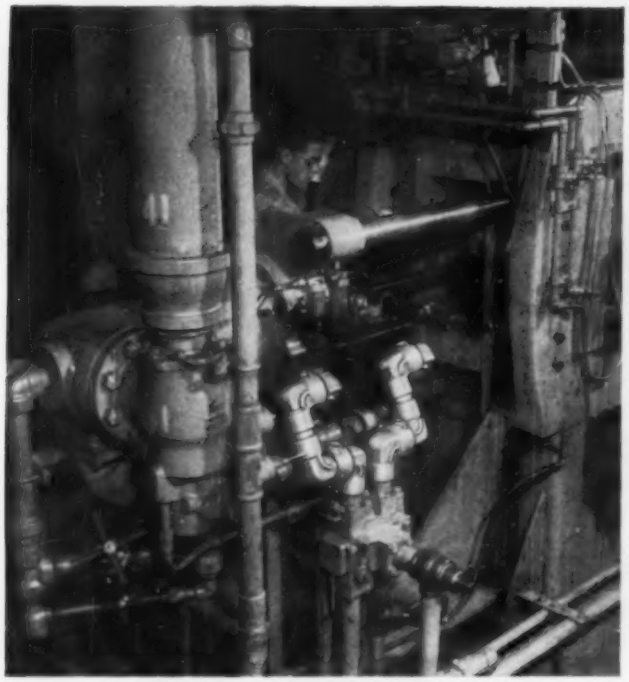
LONG SERVICE LIFE ➤
Chiksan swivel joints deliver years of service with only occasional maintenance attention. All-steel hydraulic lines on Flash-Butt welder, shown at right, allow lines to shift as machine is adjusted to handle various work.

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

fmc CHIKSAN

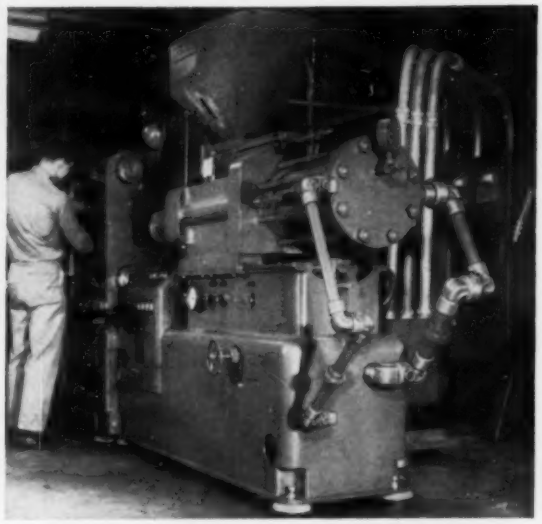
CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries Chiksan Export Company • Chiksan of Canada Ltd



NO HOSE BURST DANGER HERE...

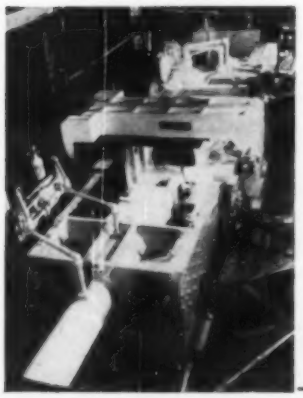
Critical lines take on a new measure of safety with all-steel flexible units replacing pressure hose. These all-metal swivel jointed lines shown on a die casting machine above, eliminate damaging hose ruptures, and reduce fire hazard, fluid loss and setup time by 75%.



PRESSURE? TEMPERATURE? CHIKSAN MEETS THE NEED...

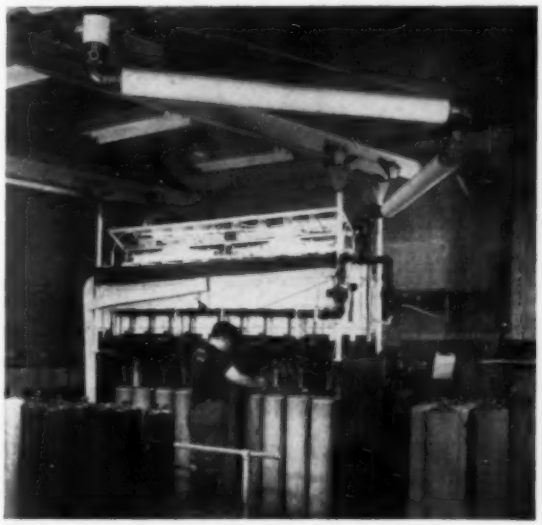
Over 2,000 different types, styles and sizes in a variety of temperature and pressure ratings are available to meet your design needs. This plastic injection molding machine, above, uses two different sizes of Chiksan swivel joints on its hydraulic lines.

JOINTS



NO LIMIT ON LINE DESIGN

Free swiveling action in 1, 2 and 3 planes permits design of compact lines to meet any requirement. This overhead line in service at a water softener regenerating plant permits shift from one setup of tanks to another for faster handling of tank regeneration.



#58-31

CHIKSAN COMPANY
330 NORTH POMONA AVENUE, BREA, CALIFORNIA

Please send me copy of your latest catalog

Name_____ Company_____

Title_____ Address_____

City_____ Zone_____ State_____

The "custom" approach to oil seal manufacture, pioneered by IPC, has resulted in some real off beat products.

None-the-less . . . they *work!* They suit the application *and,* in more cases than not, they have contributed substantially to cost savings.

When you're faced with a rugged problem involving oil seals, what synthetic compound comes to mind? How about case design? . . . friction? . . . torque? . . . shaft speeds?

Oil seals are an engineered product in themselves . . . just as good as their individual design. That's why we think each oil seal application deserves special "custom" thinking. That's why IPC oil seals are noted for performance. Let us show you what IPC can do to relieve your particular problem.

OIL SEALS / PACKINGS / PRECISION MOLDING *Custom designed for your application.*

IPC **INTERNATIONAL PACKINGS** CORPORATION

Bristol, New Hampshire

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P-1

STRONGER and SAFER for every high pressure pipeline duty...

...because they are **drop forged** *by*

Vogt

Constantly imitated but never duplicated, Vogt forged steel fittings and flanges have unmatched strength and toughness for your most severe pipeline duties. Laboratory controlled materials and Vogt's special forging techniques assure products which are always uniform in structure, fine grained, and free from porosity. Thereby the shocks and stresses imposed by high pressures and high temperatures are easily withstood, and with stubborn resistance to erosion and corrosion. Consult Catalog F-10 for our complete line of fittings and flanges.

For a copy of Vogt Catalog F-10 address Dept. 24A-FAH

HENRY VOGT MACHINE CO., P.O. BOX 1918, LOUISVILLE 1, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati

OTHER VOGT PRODUCTS

Forged Steel Valves — Petroleum Refinery and Chemical Plant Equipment — Steam Generators — Heat Exchangers — Ice Making and Refrigerating Equipment.

Vogt

DROP FORGED STEEL

Fittings and Flanges

Circle **157** on Time-Saver Card

NEW PRODUCTS

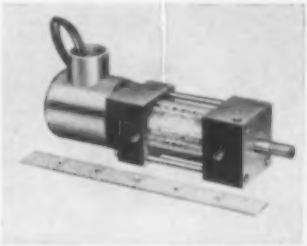
Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

CLAMP-TYPE CYLINDER
. . . for air, oil, water

Designation: CLA Series Valv-N-Hed (R)

Features: Spring-return or double-acting, with integral solenoid valve. For tooling and automated circuitry.

Specifications: 1⅛" bore; 1", 2", 3" strokes stocked. Cylinder is



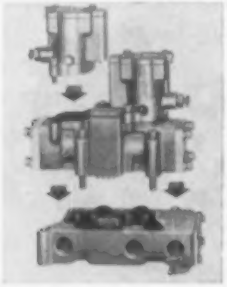
1½" square. Valve housing is 1⅜" in diameter x 2 3/16". For 150-psi air, 250-psi oil, water. For 115-v, 60-cps, continuous duty, to 180 F. Power rating is 10 w. Grommet electrical outlet, or ½" NPT conduit outlet and 24" thermaplastic covered leads. 1"-stroke cylinder weighs 21 oz.

Sheffer Corp.
Cincinnati, Ohio

Circle **300** on Time-Saver Card

SOLENOID AIR VALVES
. . . are plug-in type

Designation: Speed King



Features: Pilot-operated, 4-way control valves have 1-piece pilot housings. Aluminum bodies, subbases. Electrical and pneumatic circuits to valve and pilot are completed as units are plugged in and bolted down. Double-solenoid models have separate, coded, 4-wire circuits. Stainless steel end caps. Hard-chrome plated stainless steel stems. Pilot plungers and main valve stem are only moving parts. No springs in main valve body. Manual override optional.

Specifications: ½" valves for 35-200 psi. Separate exhaust ports are tapped ¾" NPT. ½" or ¾" NPT inlet and cylinder ports.

Valvair Corp.
Akron, Ohio

Circle **301** on Time-Saver Card

TANDEM HYDRAULIC PUMP
. . . capacities to 55 gpm

Designation: Series O-H

Features: Two separately piped sections.

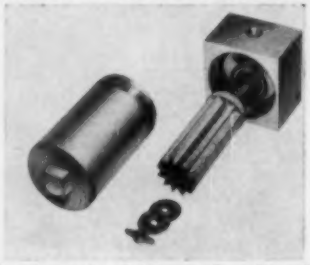
Specifications: Volumetric efficiencies, 91%; overall, 86%. Produce 1500 psi. Larger volume section in 20, 31, 44 gpm, 1200 rpm. Smaller section in 2, 3, 5, 8, 12 gpm. All but two largest can operate at 1800 rpm. Capacities: large, 30, 45 gpm; small, 3, 5, 8, 12 gpm. Minimum speed is 200 rpm.

Double A Products Co.
Manchester, Mich.

Circle **302** on Time-Saver Card

HYDRAULIC FILTER
. . . has reuseable element

Features: Reinforced, sintered bronze element filters 40 microns. 400-psi pressure drop doesn't disintegrate element. If element cracks, at higher pressure drops, downstream components are protected. Element contained in forged aluminum bowl threaded to extruded



aluminum head. No need to disturb piping to clean.

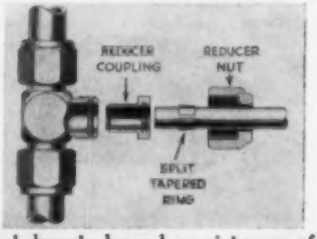
Specifications: In ⅜" size, filter area is 35 sq. in. Unit rating is 1000-psi operating pressure.

GPE Controls, Inc.
Chicago, Ill.

Circle **303** on Time-Saver Card

REDUCER COUPLINGS
. . . with O-ring seals

Features: In stainless steel, cadmium-plated steel, black phosphate, and special finishes. Standard fitting plus reducer coupling with nut and split-tapered ring. No need for hex bushings, pipe threads, or metal-to-metal seals. Effectiveness of



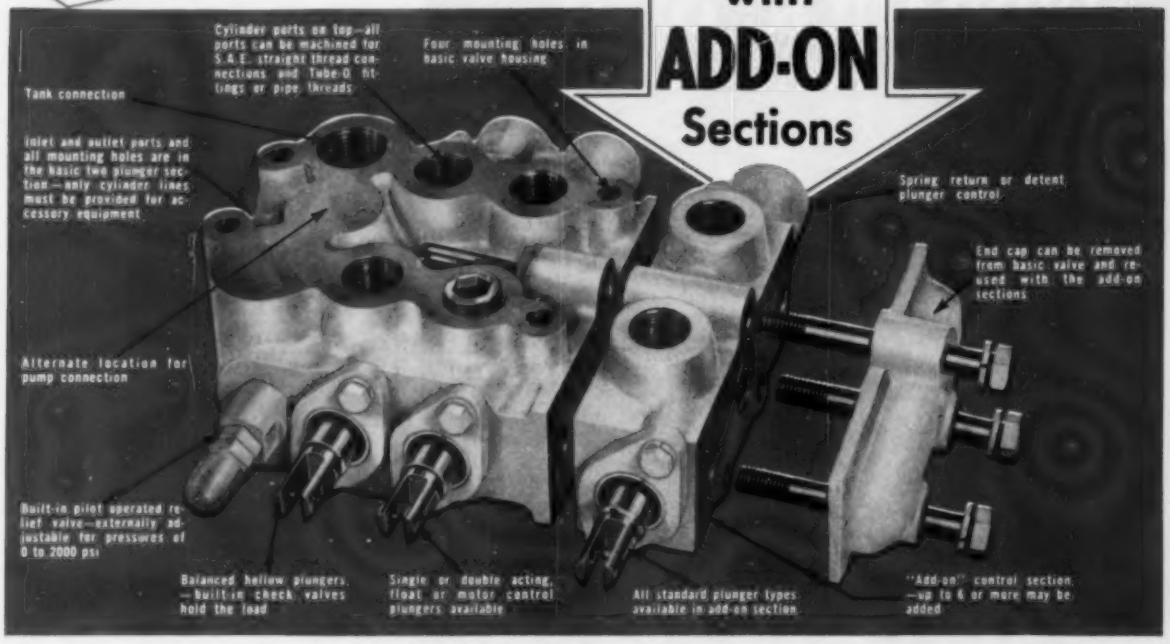
seal doesn't depend on tightness of nut. All parts reuseable. Applied to tubing of any thickness. May be used in unions, elbows, tees, crosses, and bulkhead connections.

Lenz Co.
Dayton, Ohio

Circle **304** on Time-Saver Card

Continued on page 54

new HYDRECO® CONTROL VALVE with ADD-ON Sections


Cylinder ports on top—all ports can be machined for S.A.E. straight thread connections and Tube-O fittings or pipe threads
Four mounting holes in basic valve housing
Tank connection
Inlet and outlet ports and all mounting holes are in the basic two plunger section—only cylinder lines must be provided for accessory equipment
Spring return or detent plunger control
End cap can be removed from basic valve and re-used with the add-on sections
Alternate location for pump connection
Built-in pilot operated relief valve—externally adjustable for pressures of 0 to 2000 psi
Balanced hollow plungers —built-in check valves hold the load
Single or double acting, float or motor control plungers available
All standard plunger types available in add-on section
"Add-on" control section —up to 6 or more may be added

V-34 Series—for Field Mounting of Accessory Equipment on LIFT TRUCKS • INDUSTRIAL LOADERS • FARM MACHINERY

The HYDRECO V-34 Series "ADD-ON" type Valve, recommended up to 20 gpm operation and 2000 psi, has a basic 2-plunger cast-in-block section to which additional control sections (up to 6 or more), may be added at any time.

All mounting holes, tank and pump connections and relief valve are located in the basic section . . . control functions for added accessory equipment can be provided without disturbing the original installation.

V-34 "ADD-ON" sections are pre-tested. They are packaged for easy installation in the field or in the shop.

In the Field . . . Equipment dealers have a more salable accessory package with lower installation costs and better service to the customer.

In the Shop . . . Accessory equipment can be added to machines on the floor quickly and at low cost when HYDRECO V-34 Valves are on the original installation. Deliveries are expedited . . . inventories reduced. Only one reservoir or mounting configuration required for any number of control plungers.

V-34 SERIES VALVES FEATURE THESE ADDED ADVANTAGES:

- Low pressure drop through the cylinder circuit and the open center . . . V-34 Valves handle more than rated capacity with little loss in efficiency.
- Small in size and easy to install . . . no special fittings needed.
- Exceptional throttling and operator control . . . important for load lifting equipment.

HYDRECO DIVISION
THE NEW YORK AIR BRAKE COMPANY
9004-3 EAST MICHIGAN • KALAMAZOO • MICH

Please send me information on the New HYDRECO V-34 Valve.

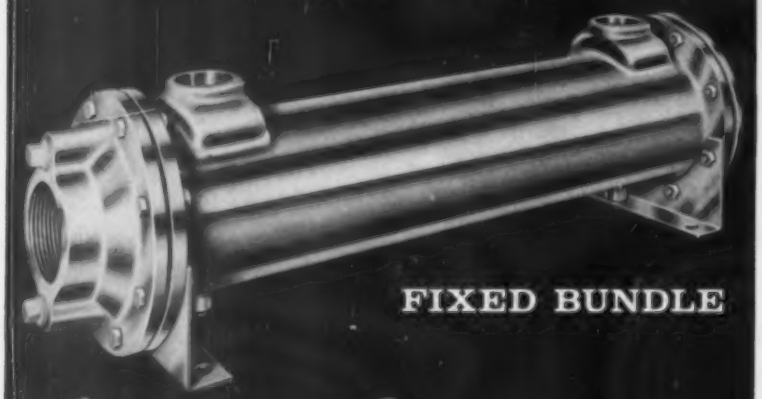
Name_____

Company_____

Address_____

City_____ Zone_____ State_____

FOR CORROSIVE TYPES OF HYDRAULIC OILS . . .



FIXED BUNDLE

Yates-American

STAINLESS STEEL

HEAT EXCHANGERS

- Stainless Steel Construction . . . all parts in contact with fluids . . . of Type 316 stainless steel.
- Rolled tube joints . . . industry's preference and standard of quality construction.
- Tube pattern . . . allows for use of wider, heavier gaskets for critical conditions of temperature and pressure.
- Wider range of capacity . . . ¼" and ⅜" tube sizes . . . unit sizes 2" to 10" diameter.

WRITE FOR BULLETIN HT-21

Over 75 years of service to industry

HEAT TRANSFER DIVISION

Yates-American

MACHINE COMPANY

705 4th St. BELOIT, WISCONSIN

HEAT EXCHANGERS / RADIATORS / AFTERCOOLERS

Circle **166** on Time-Saver Card

NEW PRODUCTS

SOLENOID AIR VALVE . . . weighs 28 oz.

Designation: Pacer

Features: Has about three times flow to solenoid ratio of most comparable models. Short poppet travel. Dust, liquid-tight seal. Cast aluminum body. Integral wiring space.

Can be manually actuated. Inoperative with captive cover removed. 3-way available.

Specifications: Cycling exceeds 1000 cpm. 5/32" min. internal orifice (NC side). Requires 7 watts. Accommodates ⅛", ¼" pipe sizes. 4-way handles 15-150 psig.

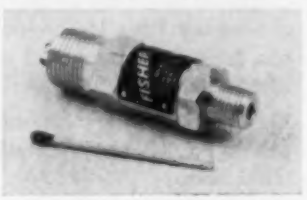
Ross Operating Valve Co.
Detroit, Mich.

Circle **305** on Time-Saver Card

IN-LINE PRESSURE SWITCH . . . weighs 2 oz.

Designation: Series 102000

Features: For air, oil, fuel. Jarring and vibration don't affect piston-type pressure sensing unit. Exter-



nally adjustable compression point controls point of actuation.

Specifications: ¼" male pipe pressure connection. ½" male pipe electrical conduit connection. For 50-3500 psi. Length, 3". Temperature range is —65 to 165 F. Electrical rating is 15 amp., 120 v. ac.

Fisher Controls, Inc.
Santa Monica, Calif.

Circle **306** on Time-Saver Card

Continued on page 56

LOOK!

LOGAN HAS IT!

RIGHT PRICE

TOP QUALITY

PEAK PERFORMANCE

in hydraulic power devices

LOGANSPORT MACHINE CO., INC.
832 CENTER AVENUE, LOGANSPORT, INDIANA

PLEASE SEND COPY OF CATALOG:

- ☐ 100-1 AIR CYLINDERS
- ☐ 100-2 MILL-TYPE AIR CYLS.
- ☐ 100-3 AIR-DRAULIC CYLS.
- ☐ 100-4 AIR VALVES
- ☐ 100-5 LOGANSQUARE CYLINDERS
- ☐ 100-6 ULTRAMATION CYLINDERS
- ☐ 300-2 PRESSES
- ☐ FACTS OF LIFE
- ☐ 200-1 HYD. POWER UNITS
- ☐ 200-2 ROTOCAST HYD. CYLS.
- ☐ 200-3 750 SERIES HYD. CYLS.
- ☐ 200-4 AND 200-7 HYD. VALVES
- ☐ 200-6 SUPER-MATIC CYLS.
- ☐ 300-1 CHUCKS
- ☐ ABC BOOKLET
- ☐ CIRCUIT RIDER

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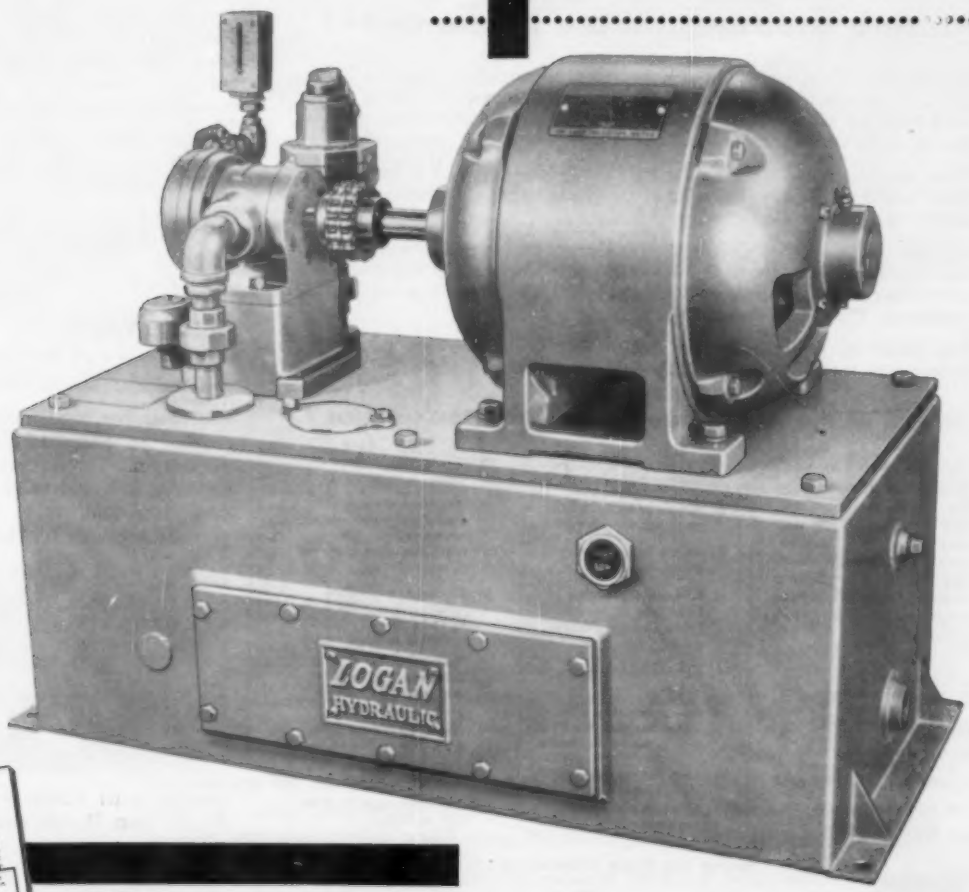
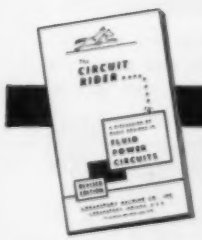
COMPANY _____

ADDRESS _____



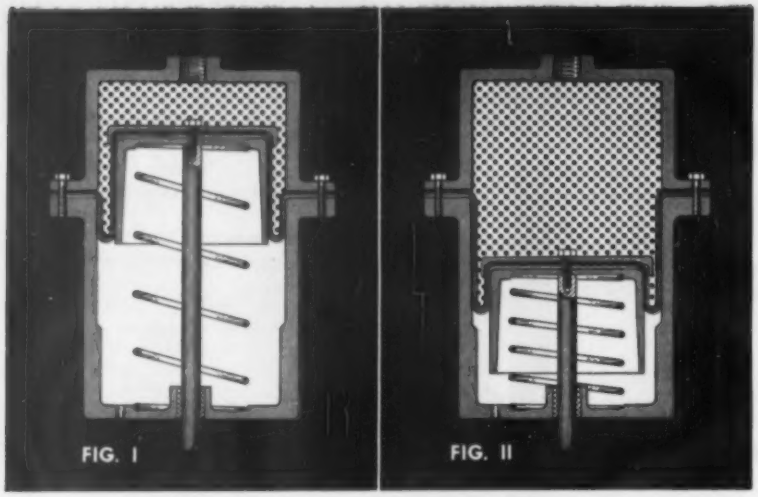
ILLUSTRATED—LOGAN MODEL 6031 HYDRAULIC POWER UNIT



FREE **SEND FOR YOUR COPY OF THE LOGAN "CIRCUIT RIDER"**

A 32-page manual on fluid power circuits (fifth edition) completely revised to present current engineering trends.

MEMBERS: Natl. Mach. Tool Builders' Assn.; Natl. Fluid Power Assn.



For Hydraulic and Pneumatic Applications

Nothing rolls like a Bellofram® Rolling Diaphragm. It's frictionless!

The Bellofram Rolling Diaphragm provides ultrasensitive response in hydraulic or pneumatic devices where frictionless, long-stroke action in small-diameter configurations is required . . . and where flex life of millions of cycles is necessary.

These desiderata are achieved through the *rolling* action of a flexible thin-sidewall diaphragm consisting of a high-tenacity fabric overlay embedded in elastomeric material.

Fig. I shows how Bellofram Rolling Diaphragm conforms to the piston. Fig. II shows how, as the piston descends under pressure, the diaphragm *rolls* off the piston's sidewall and onto the cylinder's sidewall in a smooth, continuous, frictionless movement.

The Bellofram principle can be applied widely in actuators, pumps, instruments, seals, accumulators, fluid dampers, etc.

Which of these advantages are you looking for?

To the designer confronted with situations for which conventional bellows, O-rings, or cup packings are inadequate, Bellofram Rolling Diaphragm offers a constellation of advantages found in no other product:

1. Friction-free (low hysteresis).
2. No break-out friction effects.
3. Completely leakproof device.
4. Constant area in all piston positions.
5. Almost infinite flex life (millions of cycles).
6. Sensitivity to extremely small pressure changes.
7. No mechanical spring gradient.
8. Compatibility with practically all environmental gases or fluids.
9. Automatic de-icing action.
10. Free positioning with complete relaxation at any point in its stroke.
11. Does not require close machine finish tolerances on pistons and cylinders.
12. Freedom from abrasive wear.
13. One hundred stock sizes. Four mounting configurations. Special types and sizes designed to order.
14. Excellent temperature stability, from —85°F. to 550°F. (from —120°F. to 700°F. in some cases).

Wide range of working pressures: 1 in. H_2O to 500 psi (up to 1200 psi in some cases).

Effective pressure areas from .028 to 108 sq. in.

Cylinder bore diameters from .25 to 12 in.

Extended range of stroke (.01 to 12 in.).

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®Reg. trademark U.S.A. and foreign countries • Bellofram Rolling Diaphragms are protected by U.S.A. and foreign patents.

BELLOFRAM CORPORATION, 12 BLANCHARD ROAD, BURLINGTON, MASSACHUSETTS

BRowning 2-2100 Mission 3-9000

NEW PRODUCTS

AIR PUMP
. . . and relief valve, filters

Designation: Models No. 2, 3, 6

Features: For pressure or vacuum. Produces clean, dry air. Needs no lubrication. Body and plates joined with ground finishes. No seals or

gaskets. Steel rotor shaft integrally cast into rotor. Centrifugal force seats four self-lubricating, carbon alloy vanes in rotor. Single or double shaft extension. Clockwise or counterclockwise rotation.

Specifications: Capacities from 3.9 to 32.2 cfm. Modification of Model No. 6 gives 60 cfm.

Dri-Air Pump Dept.
Conde Milking Machine Co.
Sherrill, N. Y.

Circle **307** on Time-Saver Card

NEEDLE VALVE
. . . is air controlled

Designation: Model #4888

Features: For high pressure. Stem coupled to pneumatically-operated diaphragm. Three moving parts. Controls: solenoid valve for open/close; solenoid valve with low pressure regulator for metering and

pressure relief. Diaphragm of Buna-N or nylon. Bodies and stems for corrosive and noncorrosive service.

Specifications: Line pressure/control exceeds 200:1. Sizes ⅛"-½" NPT. AND 10050 tube sizes 4-8. Overall height is 5".

Dragon Engineering Co., Inc.
Norwalk, Calif.

Circle **308** on Time-Saver Card

Continued on page 58

FROM MIDGET TO MAMMOTH

Decco®

GIVES YOU DEPENDABILITY AND TOP PERFORMANCE IN INDUSTRIAL SOLENOIDS

STROKE IN INCHES		ZERO	1/8	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
MODEL 01	100% E	4.75	4.1	2.75	2.2	1.95	1.85	1.75	1.7				
	85% E	3.75	2.7	1.85	1.50	1.35	1.25	1.15	1.1				
MODEL 02	100% E	5.5	5.0	3.9	3.1	2.8	2.6	2.5	2.4				
	85% E	4.5	3.6	2.7	2.0	1.9	1.8	1.6	1.5				
MODEL 13	100% E	5.5	3.25	2.58	2.25	2.25	2.15	2.1	2.0				
	85% E	4.0	2.3	1.7	1.6	1.5	1.5	1.4	1.4				
MODEL 15	100% E	8.0	7.0	5.8	5.25	4.75	4.6	4.5	4.5				
	85% E	6.0	4.85	4.00	3.35	3.3	3.25	3.25	3.1				
MODEL 16	100% E	12.0	8.5	7.15	6.75	6.6	6.5	6.5	6.4				
	85% E	10.0	6.1	5.15	4.75	4.6	4.5	4.5	4.5				
MODEL 17	100% E	16.0	11.2	9.9	9.0	8.5	8.1	8.0	8.0				
	85% E	14.0	8.2	7.0	6.3	6.2	6.1	6.0	6.0				
MODEL 18	100% E	18.5	14.5	12.25	11.4	11.0	10.5	10.25	10.25				
	85% E	16.0	10.5	9.0	8.25	7.75	7.5	7.25	7.25				
MODEL 20	100% E	25.0	18.0		13.5		12.5		12.5	12.5	12.25		
	85% E	20.0	12.0		9.0		8.5		8.5	8.5	8.5		
MODEL 21	100% E	35.0	20.0		16.0		15.0		15.0	15.0	15.0		
	85% E	25.0	14.0		10.5		10.25		10.0	10.0	10.0		
MODEL 51	100% E	40.0			23.0		21.0		20.0	20.0	20.0	20.0	20.0
	85% E	30.0			17.0		15.5		14.5	14.5	14.5	14.5	14.5
MODEL 52	100% E	45.0			28.0		25.0		25.0	25.0	25.0	25.0	25.0
	85% E	33.0			19.0		17.0		17.0	17.0	17.0	17.0	17.0
MODEL 53	100% E	50.0			37.0		32.0		30.0	30.0	30.0	30.0	30.0
	85% E	36.0			25.0		22.0		20.0	20.0	20.0	20.0	20.0

DECCO'S patented construction and finest quality materials have greatly extended the service life of the solenoid. Silicon steel laminations give top efficiency. Hardened beryllium-copper plungers reduce friction and wear. Shock absorbing construction assures long service life. Non-magnetic, stainless steel striker-plates . . . heavy Nylclad magnetic wire . . . high temperature flow-point, molded nylon bobbins, all contribute to the dependability and stamina which make DECCO solenoids the best buy in the market today.

There is a type, model and size DECCO solenoid for every requirement. Write for DECCO brochures #572 standard models or #581 miniature models.

Decco SOLENOIDS

DETROIT COIL COMPANY

2435 HILTON ROAD, FERNDALE 20, MICHIGAN

to designers,
engineers and users of
MECHANICAL PACKINGS

there's a PAGE Packing exactly right for any job... and you can get it FAST

A complete line — Here's your dependable source to meet all your packing requirements. Available in various leathers, with impregnations such as rubber and resin or silicone treated to meet special applications. Also a complete line of standard synthetic packings.

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Page Packings set the stage for dependable operation of hydraulic and pneumatic equipment. Send for catalog or send us your requirements.

PAGE BELTING CO. trademark

PAGE BELTING COMPANY
established 1868

Concord — New Hampshire
Page Packings — engineered to do a better job

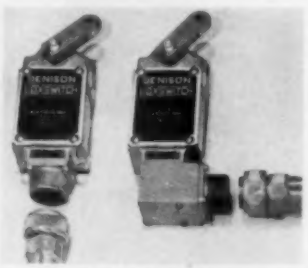
Circle **117** on Time-Saver Card

NEW PRODUCTS

LIMIT SWITCHES
. . . with plug-in connections

Designation: Model PL100W

Features: Use housing and mechanism of L100W series. Male receptacle unit permanently attached to switch, and wired directly to switch. Unit is fully sealed at switch entrance. Switch is gasketed and



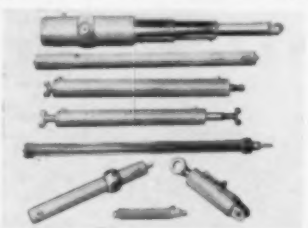
sealed. Cord half is female plug and screw collar. 4-conductor cable and plug are wired and epoxy sealed. Held together with mechanical clamp. Plug in in-line or at right angles.

R. B. Denison Mfg. Co.
Bedford, Ohio

Circle **309** on Time-Saver Card

HYDRAULIC CYLINDERS
. . . are easily modified

Features: Telescopic, single-acting, double-acting, and differential types. Variety of mountings.

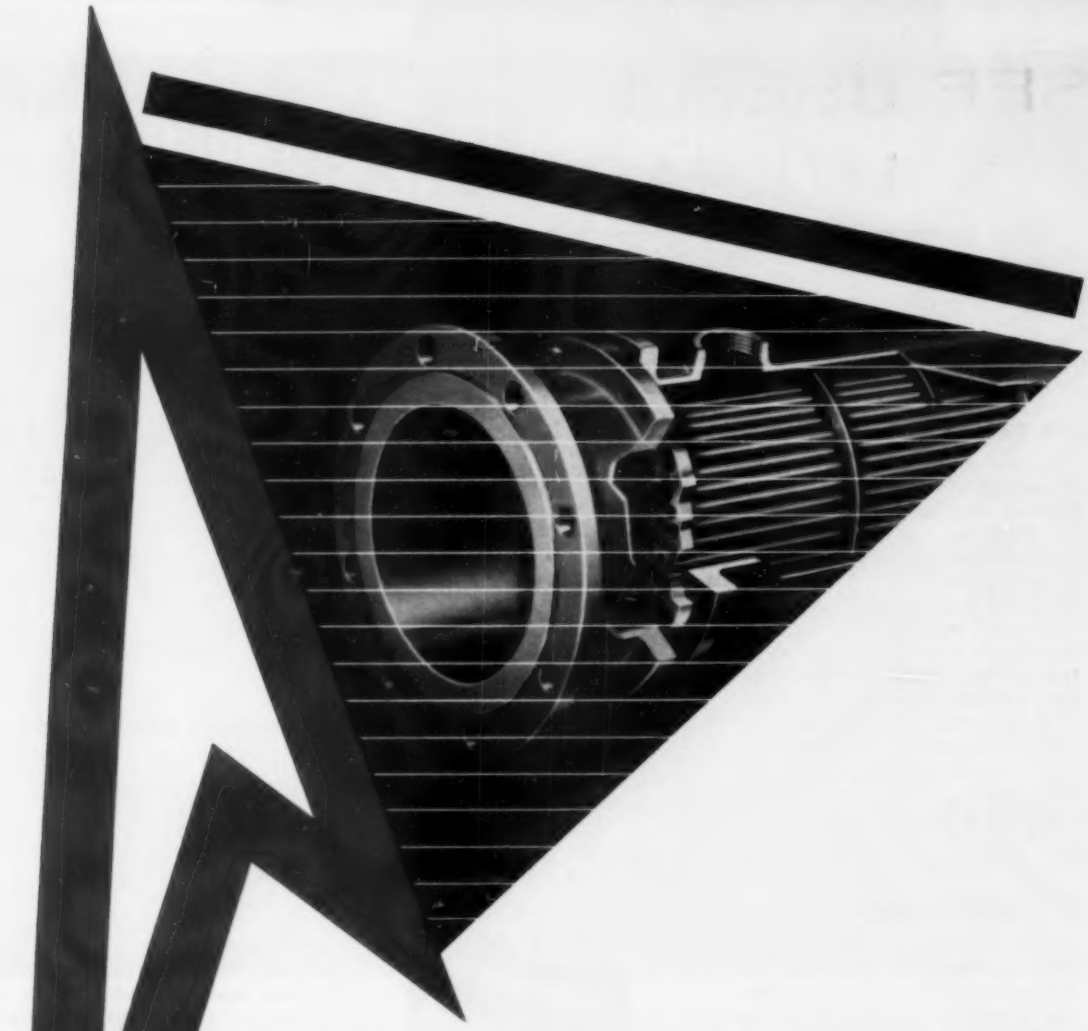


Threaded, adjusable, non-adjustable, or swivel rod ends. Concentricity of guides piloted from same diameter prevents bearing load against packings.

Hydraulic Unit Specialties Co.
Waukesha, Wis.

Circle **310** on Time-Saver Card

For more NEW PRODUCT reviews turn to page 134



54 sizes of standardized aftercoolers for clean dry air

American-Standard* pipeline aftercoolers for air compressors, made from standardized parts, cut costly engineering time, eliminate special fabrication costs. All 54 sizes feature corrosion-resistant removable tube bundle. Advanced centrifugal moisture separator is available when specified. Variety of small sizes in stock for immediate delivery. Get the full story. Send for Bulletin 302.6K1. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario.

*American-Standard and Standard are trademarks of American Radiator & Standard Sanitary Corporation

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INDUSTRIAL DIVISION
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USEFUL LITERATURE

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AIR VALVES

Replace in less than 30 sec. Loosen two cap screws. Twist pilot cap. Remove pilot cap and valve housing. Only two replacement assemblies—poppet spindle-sleeve assembly and solenoid pilot assembly. Weighs 4 lb. ½" NPT. Flows 335 cfm at 100 psig initial pressure to atmosphere. Short-stroke pilot is extremely fast. Application information. Cutaway drawings show flow with solenoid energized, deenergized. Dimensioned drawing. Bulletin 594. *Hunt Valve Co., Salem, Ohio.*

Circle **400** on Time-Saver Card

CYLINDER TUBING

Electric welded tubing is drawn over mandrel. Close tolerances and ID surface of this cold-drawn tubing eliminate honing in many cases. Can be used as received. Improved concentricity reduces machining operations. Electronic tester detects pits, seams, slivers, undesirable variations in chemistry and hardness. Bulletin contains specification data. *Jones & Laughlin Steel Corp., Pittsburgh, Pa.*

Circle **401** on Time-Saver Card

GASKETS

Rubber-to-metal bonded gaskets for static sealing. Brochure gives physical properties, application information, seal configurations, design information, dimensional requirements, and material selection tables. 8 pages. *Stillman Rubber Co., Culver City, Calif.*

Circle **402** on Time-Saver Card

SELF-SEALING COUPLINGS

Standard and quick-connect couplings have nonmetallic seats. Seat absorbs action of spring-loaded poppet, adjusts to irregularities from excessive metal-to-metal wear. Bulletin S-6. *Stratoflex, Inc., Ft. Worth, Texas.*

Circle **403** on Time-Saver Card

HEAT EXCHANGERS

Single pass and multipass models of copper base alloy, steel, and stainless steel. Type HF exchangers for hydraulic fluids rated at 250 psi on shell side. Tubes are high-temperature bonded into headers for maximum cooling surface area per volume. Stainless steel type SSF exchangers are acid and corrosion-resistant. They meet JIC standards.

Catalog has application photos, pressure rating and materials charts. Selection data includes heat-transfer formulas, and charts of coefficients, effective tube surface areas, and allowable flow rates. Full-page, two-color graph of temperature vs. viscosity (in SSU and centi-stokes), for SAE 10, 20, 30, 40, 50, 60. Drawings and table of weights and dimensions. Catalog 1258A. *Young Radiator Co., Racine, Wis.*

Circle **404** on Time-Saver Card

ELECTRICAL CONTROLS

Covers starters, contactors, relays, solenoids, limit switches, pushbuttons, static control, and pilot devices. Contains starter selection charts for motors from ¼ to 200 hp. Figures, wiring diagrams, dimensions, application information. Handbook reference and supplemental bulletins listed for each type. Catalog GEC-1260D, 72 pages. *General Purpose Control Dept., General Electric Co., Schenectady, N. Y.*

Circle **405** on Time-Saver Card

PRESSURE GENERATORS

Develop static pressures for gage testing and pressure measurement systems. Each revolution can be translated into a positive displacement. Floating O-ring packing. Threading tool has interchangeable dies and bushings for ¼", 5/16", ⅜", 9/16" tubing. Another tool for ⅛". Coning tool for each tube size. Some tools have interchangeable blade and collet. Micro reactors and their covers listed. Catalog 859. *High Pressure Equipment Co., Inc., Erie, Pa.*

Circle **406** on Time-Saver Card

HIGH-PRESSURE PNEUMATICS

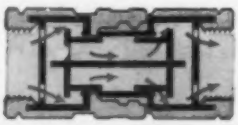
Central compression systems for high-pressure helium, nitrogen, and air. 4 and 6-stage models have 4, 6, or 8 cylinders. Deliver from 47 to 170 scfm. Pressures to 12,000 psi. Crankcase can be vented to atmosphere. All systems have drive motor and starter, automatic controls, control panel and gages, intercoolers and aftercooler, trap for each stage, automatic unloader. Purification systems have mechanical separator or refrigeration system. Pressure vessel has 10,000-psi working pressure. Catalog 125. *High Pressure Pneumatics Div., Airdox Cardox Products Co., Chicago, Ill.*

Circle **407** on Time-Saver Card

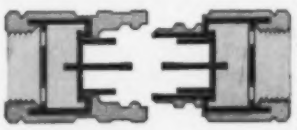
Continued on page 63

There's a size and type to handle almost anything that flows

TO USE SNAP-TITE VALVED COUPLING:



CONNECT—Full flow instantly



DISCONNECT—No flow instantly

Snap-Tite can provide the right size valved coupling for most any use . . . with quick off-on action wherever coupling or shut-off is required.

"H" series valved couplings for high pressure applications. High resistance to heavy line surge. Sizes from ⅛" through 6". Larger sizes on special order.

"IH" series valved couplings for greater impact in air lines. ⅛" through ½".

"E" series valved couplings for vacuum and very low pressure. Recommended for gravity flow. Sizes from ⅛" to 6". Larger sizes on special order.

"T" series valved couplings for hard to handle fluids. The only valved quick-disconnect couplings now on the market for fluid temperatures from −40°F to +400°F. Sizes from ½" through 3".

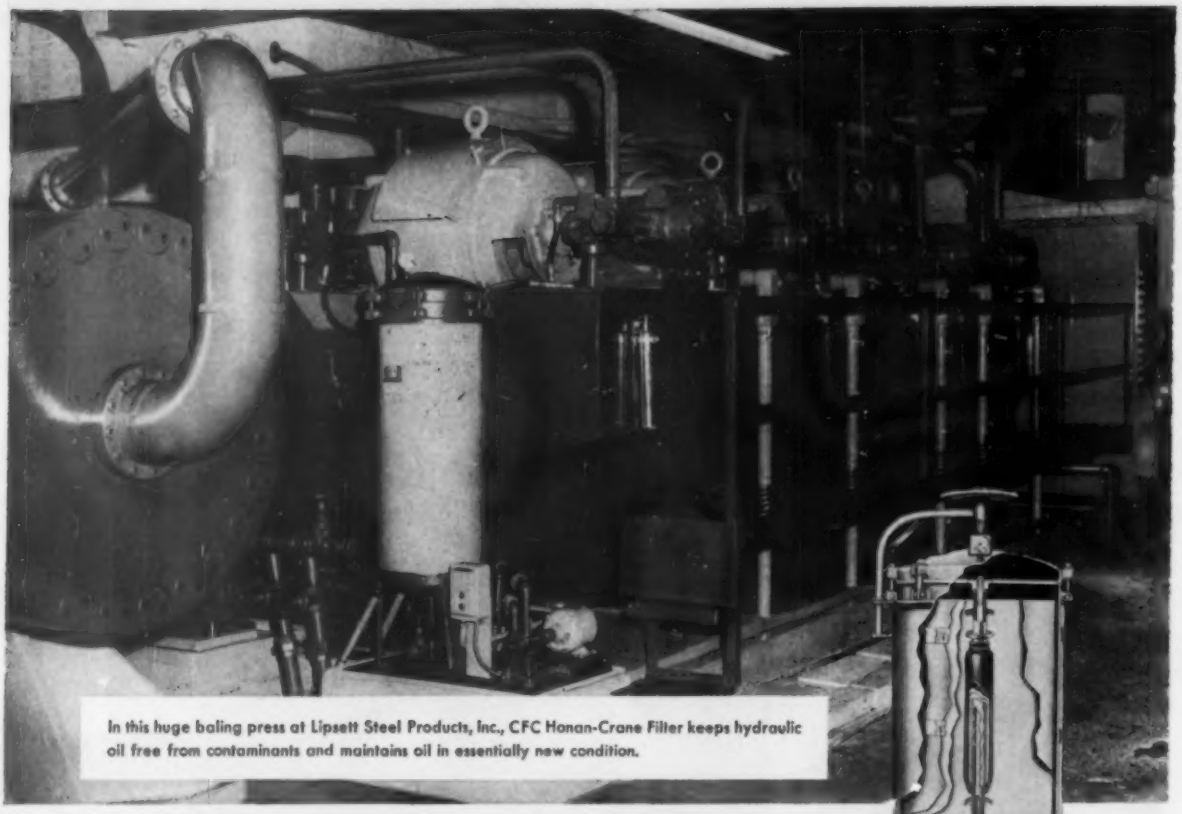
Snap-Tite valved couplings are available with two-way or one-way automatic line shut-off. They are normally furnished in alloy steel. Also available in brass, aluminum, or stainless steel with a variety of finishes.

Write for Snap-Tite Catalog No. 58 for more information on Snap-Tite valved couplings.

★Snap-Tite

UNION CITY 1, PA.

57-59-02



In this huge baling press at Lipsett Steel Products, Inc., CFC Honan-Crane Filter keeps hydraulic oil free from contaminants and maintains oil in essentially new condition.

No oil change in over a year with CFC HONAN-CRANE HYDRAULIC FILTER

Reduced down time and lower maintenance costs are achieved by Lipsett Steel through the use of a CFC Honan-Crane Hydraulic Filter on this large baling press. The machine operates 10 hours a day, five days a week — yet no oil change has been necessary since the machine was installed over a year ago. No maintenance is required except changing the filter media once every two months.

The CFC Honan-Crane Bulk Type Refill Filter provides positive protection against all types of oil contamination — for engine lube oils, quench oils, hydraulic oils, roll oils, cutting oils and turbine oils. It employs inert filter media, cellulose filter media or Cranite (fuller's earth).

Write for technical literature on the complete line of CFC Filtration Equipment to Department AH.

CFC

COMMERCIAL FILTERS CORPORATION

Fulflo Honan-Crane Delpark Michiana

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

USEFUL LITERATURE

3-WAY VALVES

For liquid and gas to 250 psi, and vacuum. Pipe sizes ¼" to 1". Solenoid-pilot operated valve can be NO, NC, or universal. Pilot valve is internal-manifold ported. No external piping to pilot. Hand-foot-cam valves have one internal moving part. Pressure can be applied to any port. Pilot and time delay pilot valves are self-compensating. External pressures can be through other media. Solenoid valves in ¼"-¾" NPT. Economy valves: solenoid, cam and pilot, hand and foot. Each type described by drawing, parts list, dimensions. Other specifications and features given. Bulletin 97023. 12 pages. *Airmatic Valve, Inc., Cleveland, Ohio.*

Circle **408** on Time-Saver Card

ELECTRO-HYDRAULIC SERVO SYSTEMS

Standard components pre-engineered into closed loop systems for machine tools, fabricating mahines, and processing equipment. Electrical feedback monitors. Velocity control systems for 0-20, 20-50, and 50 hp up. Positional control with hydraulic motors or cylinders. Positional accuracy of .0005" with motor and lead screw; .001", with cylinder. Systems use any type electronic programming. Bulletin 59-75. *Vickers, Inc., Div. Sperry Rand Corp., Machinery Hydraulics Div., Detroit, Mich.*

Circle **409** on Time-Saver Card

ROTARY COMPRESSORS & VACUUM PUMPS

Single-stage compressors have capacities from 32 to 1554 cfm. Require 5-250 hp. Two-stage compressors have 115-1592-cfm capacities. Require 25 to 350 hp. For 100 psi, 30-300 hp needed. Vacuum pumps deliver 44-1582 cfm at 10" Hg, 0-505 cfm at 29" Hg. Compressors need no reduction gearing for direct drive at ordinary motor speeds. Automatic intake regulator. Two-stage compressors fitted with intercoolers. *Fuller Co., Catasauqua, Pa.*

Circle **410** on Time-Saver Card

AIR HOSE

From 3/16" to ½" ID, from ⅜" to 1" OD. Wall thicknesses are .025", 3/32", 1/16", ⅛", 5/32", 3/16". Doesn't craze, crack or deteriorate with age. Operating temperatures from 0 to 175 F.; pressures, to 125 psi. Test lengths available. *Munray Products Div. Fanner Mfg. Co., Cleveland, Ohio.*

Circle **411** on Time-Saver Card

MAGNETIC SUMP STRAINER & FILTER

In one unit. Needs no extra openings in reservoir. Disc screens remove dirt and sludge; permanent Alnico magnets trap iron particles. All fluid passes through strainer's field. Filtering area of disc screens kept free of iron particles. Iron particles drop off disc covers when disassembled. Filters to 85 gpm *Riply Screen & Strainer Co., Farmington, Mich.*

Circle **412** on Time-Saver Card

PIPE MARKERS, ELECTRICAL MARKERS

Name of item printed on color-coded, vinyl plastic strips. Apply in 10 sec. Non-absorbant, non-porous, color-fast. Hold fast at extreme temperatures. Adhesive numbers and letters available. Meet ASA A13. 1-1956 recommendations. Bulletin 803 illustrates applications, lists all markers available, describes styles. *Seton Name Plate Co., New Haven, Conn.*

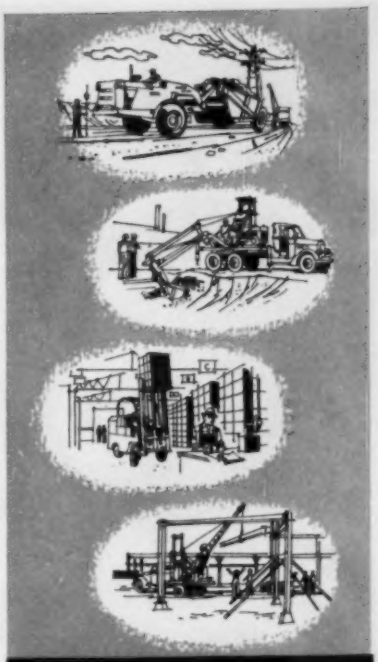
Circle **413** on Time-Saver Card

RELIEF VALVE

Screwed or flanged ends. Bronze or steel bodies. Cast steel diaphragm housing. For pressures to 500 psi (1200 psi special), to 250 F. ½"-2" sizes. Drawing, dimensions, parts list given. Application shown. Chart of maximum flow rates. No. 280, Type G. *Atlas Valve Co., Newark, N. J.*

Circle **414** on Time-Saver Card

For more reviews of FREE LITERATURE turn to page 150



HIGH PRESSURE IS
CONTROL

High pressure systems have inherently superior control due to the small mass of fluid accelerated, the smaller more rigid hose and tube lines, the reduced effect of fluid compressibility at high pressure, and reduced seal drag on the smaller components.
Dynex has designed two series of valves, a poppet and a slide type series, for precision control in high pressure circuits. Both series give flow control in almost direct proportion to valve movement making extremely accurate control possible. The poppet series has "zero" leakage in the center position and both valves are free of dynamic unbalance at opening and closing. Normal spool valves cannot approach their precision control. Write for bulletin DG-3.

DYNEX INC.
BLACKHAWK
IS HIGH PRESSURE
777 DYNEX DRIVE • PEWAUKEE, WISCONSIN
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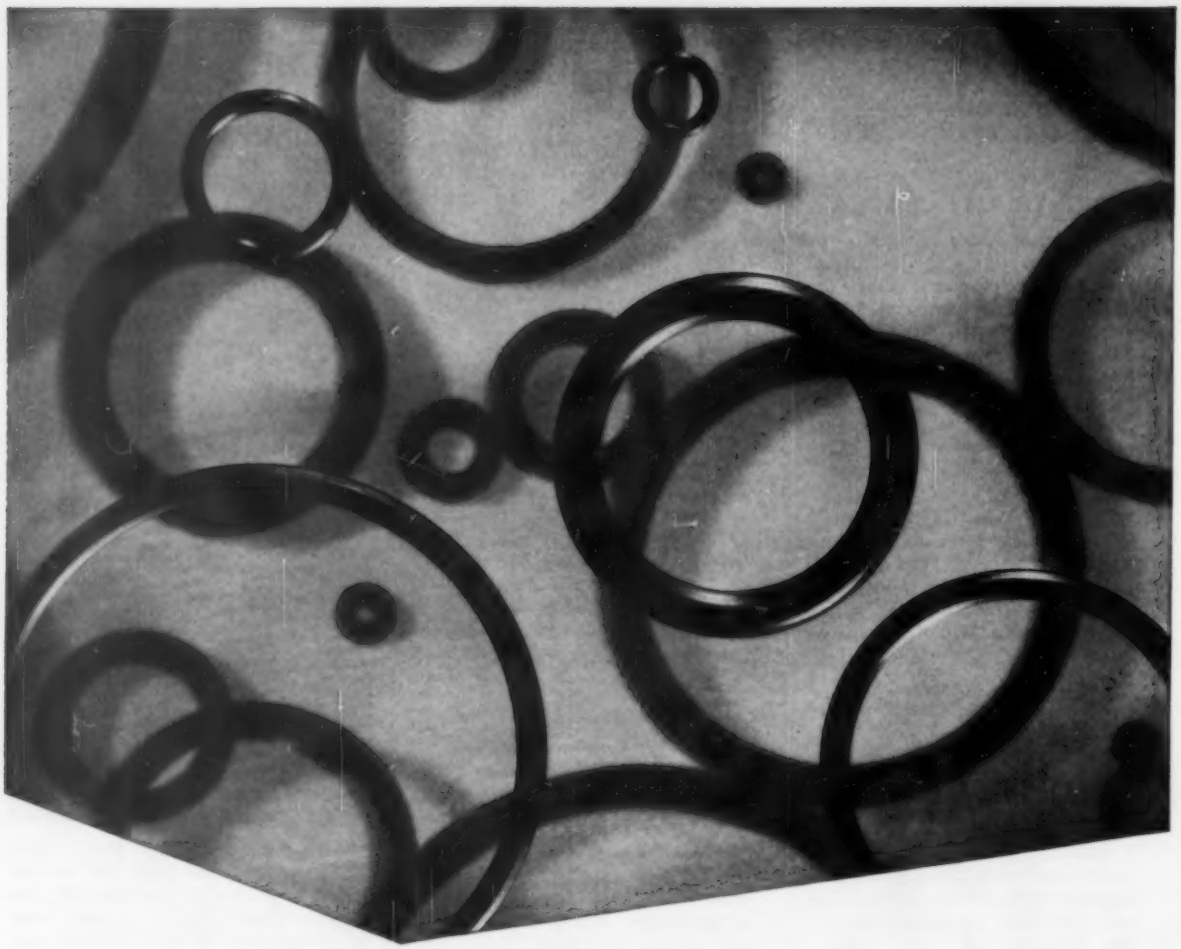

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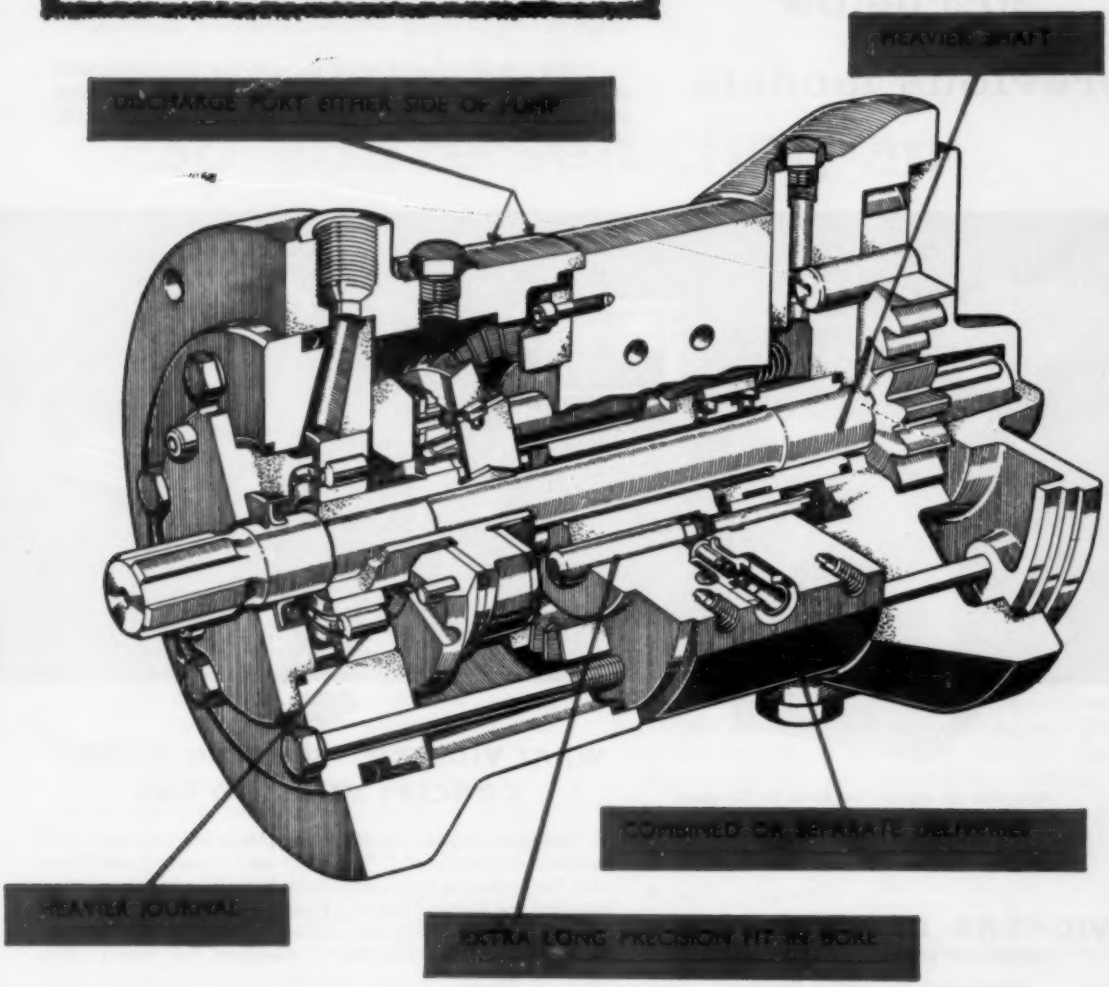
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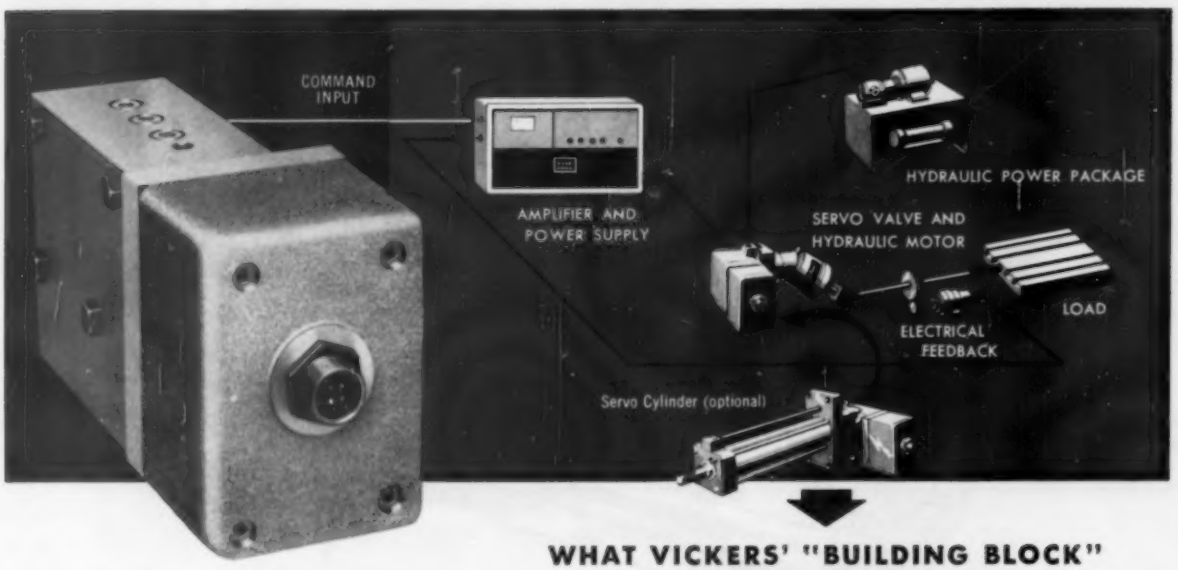

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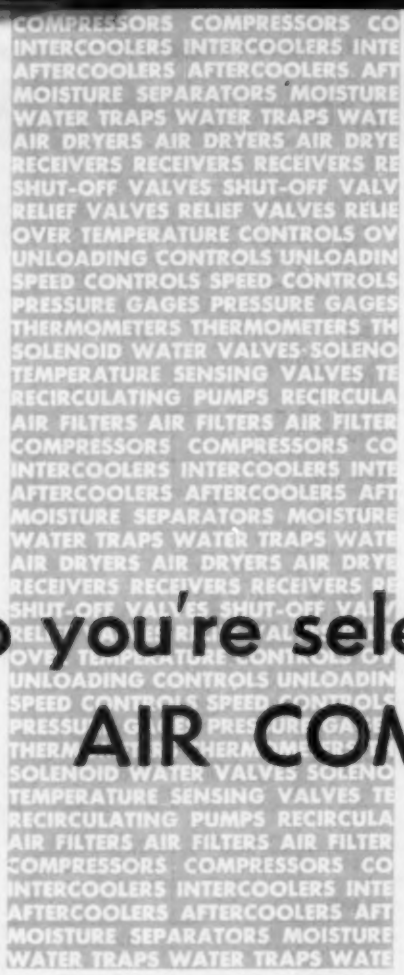


So you're selecting an AIR COMPRESSOR

● By ALLAN E. MORRIS, *Editor*

SELECTING an air compressor can be a matter of a few phone calls. There are at least a dozen major manufacturers of compressors for supplying plant air, and hundreds of qualified distributors who can engineer the whole job from the air intake filter to the system shutoff valve. But each installation—the compressor itself, its controls and protection, air filtering and cooling—must be worked out to meet specific plant requirements. The best design considers:

- Present requirements and future expansion
- Standby needs and the cost of losing the air supply
- Air-operated equipment in the plant, its duty cycle and pressure requirements
- Operating expense compared with original cost
- Automatic protection for unattended operation
- An evaluation of present air supply equipment

No one knows your plant like you do. So before spending thousands of dollars on a compressor and auxiliary equipment, its smart to learn as much as you can about what makes a good design, and how to talk intelligently with the experts. Then you can measure what's available against what you need, now and for the future.

Air compressor selection is mostly an art, based on years of experience, confidence in a company's reputation, and a feel for your plant's operation and growth pattern. But the better you understand air compressor design, and the components that go along with them, the better you can satisfy yourself that your choice is best and will give *you* most efficient operation.

WHO NEEDS AIR?

You do when you:

- Build a new plant
- Expand your facilities
- Have compressors that always run loaded and fail to maintain desired pressure

Once you've *made* the decision to add air capacity, your problems are multiplied. First on the list are how big a compressor, how many, where to put them.

Design studies show how 8 companies supply their compressed air

Air compressor specifications from these 25

MANUFACTURER	MODEL	TYPE	STAGES	SPEED (rpm)	HORSEPOWER	CAPACITY (cfm)	COOLING	CONTROL
AIR-FLO COMPRESSOR CO.	SF, A, K-	reciprocating	1 or 2	400 to 900	¼ to 40	1 to 210	fin tubing	single inlet guide vanes
		rotary	1	870 to 1750	1 to 100	5 to 500	air or water	none needed
ALLIS-CHALMERS MFG. CO.	H-17S & L	rotary	2	690	199 to 319	1133 to 1337	tube intercooler	inlet unloading valve
	H-19S & L			575	275 to 450	1588 to 1807		
	H-11S & L			865	120 to 188	681 to 790		
	H-12S & L			865	157 to 242	893 to 1015		
BELL & GOSSETT CO.	SYC17-1, SYCO12-1, SYCT104-1	reciprocating	2	1725	¾	2.2	air cooled	automatic pressure switch
BURY COMPRESSOR CO.	URB	reciprocating	1	200 to 500	10 to 150	60 to 1300	water jacketing	step unloading
CAMPBELL HAUSFELD CO.	QR 2001	reciprocating	1	700 to 860	1			
	PK 2028	reciprocating	1	650 to 1090	½ to ¾			
CLARK BROS. CO.	ICA-6	reciprocating	2	720	75 to 150	407 to 10,540	shell and tube	step unloading
	CMA-2			600	200 to 300			
	CMB-2			514 to 600	350 to 400			
	CJA-2			400	500 to 600			
	CRA-2			327	800			
	CRA-4			327	1000 to 1500			
	CBA-4			300	1750 to 2000			
COOPER-BESSEMER CORP.	DMR-2	reciprocating	2	720	100 to 250	407 to 1410	shell and tube	step unloading
	DMR-3			720	300 to 350	1670 to 2005		
	EM			450	200 to 350	1125 to 2005		
	FM			400	400 to 600	2024 to 3190		
	JM-2 & JM-4			300	600 to 2000	3190 to 10,550		
CORNELIUS CO.	3790100	reciprocating	2	to 3600	3	7	air cooled	
CURTIS MFG. CO.	C-100	reciprocating	2	400 to 850	25 to 40	102 to 217	air cooled	suction valve unloaded
	C-96, C-97, C-98		2	350 to 800	3 to 20	12.8 to 108		suction valve or vacuum unloaded
	C-90		2	400 to 850	1 to 2	4.6 to 9.9		suction valve or centrifugal
	C-15, -40, -50, -80		1	400 to 800	½ to 5	2.8 to 25.4		
DAVEY COMPRESSOR CO.	Hydrovane	rotary	Multi	1800	2 through 5	8 to 20 (125psi) 6 to 15 (200psi)	Oil cooled	Modulation
				1200-1800	20 through 125	80 through 520 (100psi)		
	Stationary	reciprocating	2	900 through 1800	10 through 100	40 through 440 (100psi)	Tube intercoolers	Intake unloading
			1			50 through 550 (40psi)	Tube aftercooler	Inlet valve unloading
THE DeVILBISS CO.	120, 130, 1202	reciprocating	1	400 to 875	⅓ to 2	.85 to 6.8	air cooled	pressure switch or unloader
	220, 230, 330		1 or 2	300 to 850	½ to 3	2.6 to 10.9		
	432, 445		2	300 to 900	2 to 15	16.1 to 50.1		
DUNHAM-BUSH, INC. BRUNNER DIV.	Single stage	reciprocating	1	400 to 800	¼ to 50	.6 to 200	air cooled	pressure switch & suction valve unloading
	2-stage		2	310 to 890	1 to 50	4 to 200		
FULLER CO.	C-15-15H through C-300-300H	rotary	1 or 2	575 to 1750	5 to 800	30 to 3300	tube intercooler	intake regulator
GARDNER-DENVER CO.	AA, AB, WB, WA	reciprocating	1 or 2	400 to 870	5 to 200	30 to 1150	tube intercooler	valves
	AC, AD, WX		1 or 2	225 to 870	¼ to 200	2 to 1150	AC, AD are air cooled	
	RX, HA		RX=1 HA=2	200 to 514	20 to 35	100 to 2010	water cooled passages	
THE KRAISSL CO. INC.	Class 21	rotary	1	1200 to 1800	¼ to 1	.5 to 5		
	Class 23				¼ to 2	5 to 20		
	Class 25				¼ to 25	1 to 170		

manufacturers give you a wide choice

MANUFACTURER	MODEL	TYPE	STAGES	SPEED (rpm)	HORSEPOWER	CAPACITY (cfm)	COOLING	CONTROL
INGERSOLL-RAND CO.	T-30 Series T-40 Series	Reciprocating air-cooled	2	500-1180	1-125	24-686 (piston displacement)	Tube intercooler Radiator (T-40)	Free air unloader (T-40)
	ESH, ESV	Reciprocating water-cooled	1	400-675	20-150	108-1593 (piston displacement)		Free air unloader
	PHE, PLE, PRE, XLE	reciprocating	2	164-720	75-2000	515-11,870 (piston displacement)	Tube intercooler (XLE) Shell-tube (PRE, PHE, PLE)	Free air unloader; clearance control
	HHE	reciprocating	2	327-400	400-2000	2400-12,300	Shell-tube	Free air unloader
	XPV	Reciprocating (steam drive)	2		200-2500	1050-8036	Shell-tube	Speed
JOY MFG. CO.	Airvane	Rotary	2	1750 to 2000			oil cooler	engine speed & valving
	WN-224	reciprocating	1, 2, 3, 4	514	350 to 1250		water cooled	5-step electro-pneumatic
	WL-80	Reciprocating	2	1160	15 to 125		air cooled	constant speed electropneumatic
	WG-9		1	450 to 600	15 to 75		water cooled	constant speed and dual
	WN-112		1 or 2	585 to 600	75 to 150			automatic and 3-step
	WN-114		1, 2, 3, 4	600	200 to 300			electro-pneumatic
LE ROI DIV., WESTINGHOUSE AIR BRAKE CO.	S2 series	reciprocating	2	870	25, 50, 75, 100	105 to 450	air cooled	constant speed, start-stop or dual control
	YC series	reciprocating	2	350 to 850	1½ to 15	7.4 to 67.7		
NORWALK CO.,	TR-ST	reciprocating	2 to 6	75 to 250			shell and tube coil and tank	non-automatic
QUINCY COMPRESSOR CO.	200 series, WW64, WW80	reciprocating	1	400 to 900	1½ to 15		200-air cooled WW-water cooled	suction valve unloading
	300 series		2		¾ to 20		air cooled	
SCHRAMM, INC.	50	reciprocating	1	900 to 1800	7½ to 15	25, 32, 50	air cooled	inlet valve unloading, pilot valve
	105			935 to 1370	20, 25, 30	85, 105, 125	water cooled	
	210, 315			935 to 1180	40, 50, 60, 75	168 to 315	water cooled	
	420			1180	100	420	water cooled	
	600		1, super charged		150	600	water cooled	
WAYNE PUMP CO.	W356, W376, W3-96, W6148, W6208	reciprocating	2	350 to 660	1 to 5	5 to 20 @75% vol. eff.		
	W6308, W6408, 77412H, 79612H		2	490 to 704	7½ to 20	30 to 96 @75% vol. eff.		
WESTINGHOUSE AIR BRAKE CO., INDUSTRIAL PRODUCTS DIV.	2 CMB, 3CMB	reciprocating	2	490 to 750	22 to 44	78 to 150	air cooled	inlet valve unloaders
	4-2		1	620 to 720	22 to 26	85 to 95	water cooled	
	Steam-driven		1 or 2	100 to 131 single strokes/min		35 to 150	air cooled	pressure controlled steam throttle valve.
	6CMB		2	860	127	410	air cooled	inlet valve unloaders
WORTHINGTON CORP.	Type C & Type M air cooled	reciprocating	1 & 2	870-1750	1-100	1-438	Air-cooled intercooler	Automatic start, stop. Suction valve
	HB (Single frame)		1	277-550	5-150	40-500	Water-cooled cylinder jackets	Automatic start, stop & step
	YC, DYC (Single frame)		2	450-600	75-350	400-2000	Water-cooled cylinder jackets with interstage shell-and-tube	
	DC, ODC, BDC (Duplex, 4-cornered opposed, balanced opposed)		2	164-400	250-2000	1300-10,000		Step
	ODP & OXP (Duplex frame with opposed steam and air cylinder)		2	140-327	55-1250	250-7000		Steam valve shut-off and steam throttling governor
YORK CORP.	Turbomaster	Centrifugal	2 to 8	3000 to 15,000	50-3000		None	Inlet guide vanes

HOW MUCH AIR DO I NEED?

If you're lucky enough to have recording equipment in your present compressor installation, you have a continuous record of how much air you're using. By working different departments, or different machines, you can get a clear picture of where your critical air loads are.

But if you need more air for a planned expansion, or haven't recording equipment available, your best bet is a study of plant operations. That means listing each air tool, cylinder, and air motor (plus other jobs like sand blasting, boiler blow down) and adding up total consumption after applying a factor based on duty cycle.

This loading factor should be based on time and motion study figures. Example: a screw driver and drill may be used by the same man. He drills a series of holes, then he puts down the drill and uses the screw driver. Loading of each tool is only 50%. But he has to put in the screws, so that cuts the factor to about 30%. Other motions in the operation would probably trim the figure to 15%, and when coffee breaks, smoking, lunch are considered, 10% is probably a realistic factor.

Once you've come up with the best figure of actual air usage, begin adding for air losses, and future expansion. Although there's no excuse for it, air losses can range to 25% of the demand. Losses like this are usually from a lot of little leaks that are "too small to fix." Actually if the situation were analyzed, the cost of repairing the leaky system would be more than made up by air savings. It depends a lot on how big a distribution system you have, but 5% loss or less seems to suit most plant men as ideal.

Future expansion often comes faster than expected. As more operations become air-operated, extra capacity is soon used up, and you're in the market for still another compressor. A lot of small units in one location is not economical compared to a few large ones, so it's better to buy for the future, even if it's five years off.

One pointer to keep in mind before adding a new compressor is the possibility of using an extra air receiver. Sometimes storing air under pressure near the point of use is a cheap way of supplying peak demands without investing in a compressor.

HOW MANY COMPRESSORS?

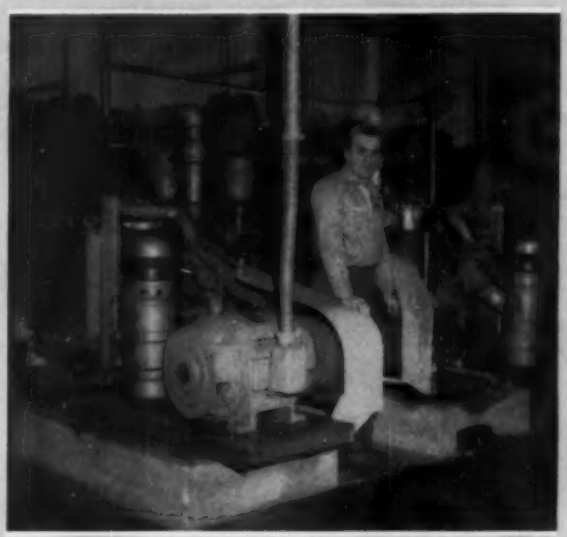
Should you buy one big compressor, or several small ones? It's a matter of weighing the higher cost of multiple units against the cost of a production shutdown if you lose air capacity. Usually multiple-unit installations result from adding compressors as needs increase. This means a bigger investment in air compressors and controls, a penalty for poor planning in estimating future needs.

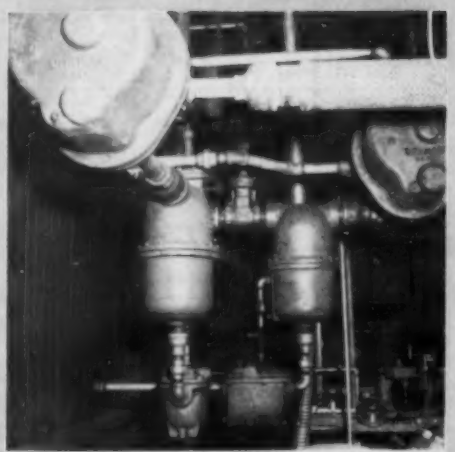
In setting up new installations, one big compressor costs less than several smaller ones, and with unloading control its output follows air requirements. Further-

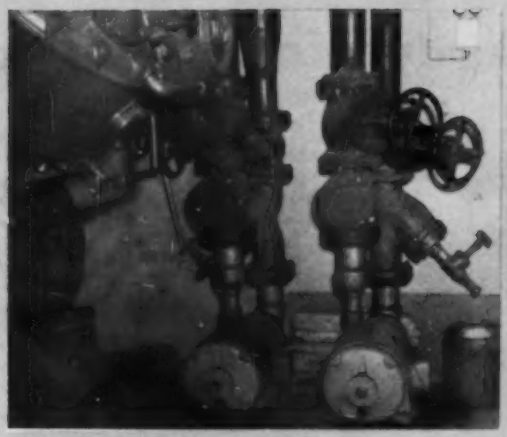
Duplicate compressor for standby and future expansion

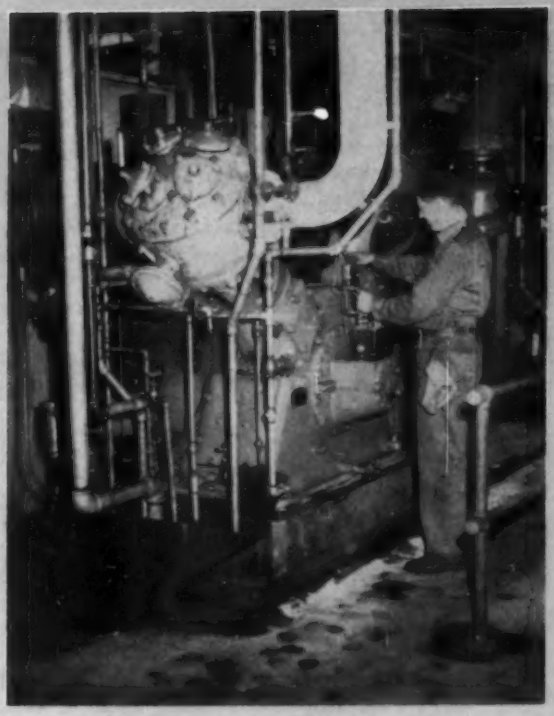
Compressed air is vital to operation at Dan Dee Pretzel and Potato Chip Co. It lifts potato frier lids, peels potatoes, and packages the finished product. Without it they'd have to shut down. So when they decided to replace an old compressor that was working constantly, they doubled capacity with two compressors.

In a food plant such as this, the keynote is cleanliness, and this goes right back to the compressor. An oil type, inlet filter protects the compressor against dirt. Each unit has its own aftercooler, moisture separator, and drain trap. The compressors are connected into the system through a length of corrugated hose, reinforced with steel braid. This isolates vibrations and protects against loose piping joints.









Recirculate water for five compressors

Cost of cooling water for compressor capacity at Modern Tool & Die would be enormous, so they installed a cooling tower on their 1-story roof and piped up recirculating pumps. The system also handles cooling water for the metal fabricating plant's welders.

Growth of this plant is reflected in its compressor needs. First change in the original setup was to boost from 80 cfm capacity. Although they bought a 50-hp compressor, they didn't actually need that much, so they slowed it from 450 rpm to 240 rpm and ran it with a 30-hp motor. It then delivered 127 cfm and the additional capacity could be had with a change in motors.

Next step was a duplicate compressor as a standby, and when more air was needed, 50-hp motors were put on both units, and they were driven at 450 rpm delivering a total of 434 cfm.

After a few years, the plant went to 24-hour operation and they bought a 2-stage, 100-hp compressor delivering 550 cfm. A few years later they were short of air again and added a 150-hp machine. Recently they again added capacity, this time a 200-hp unit delivering 1200 cfm.

The five compressors now in operation each have their own aftercooler and tank. This arrangement gives adequate storage and still keeps the tanks small enough to be suspended from the ceiling. It also gives good flexibility and permits working on any compressor or control while the others are supplying the plant.

The compressors Modern Tool selected have replaceable cylinder liners for easy maintenance if the cylinder is accidentally scored. Water temperature switches shut off the drive motor at 140 F to prevent overheating. Cooling water is circulated first through the aftercooler, then through the cylinder jackets, so it is already heated by the time it reaches the compressor. This prevents condensation in the compressor cylinders, rusting, and valve breakage. It also requires less piping and less water than cooling each separately. A water-temperature control valve meters water inlet to keep an outlet water temperature of 100 to 110 F.

more, its control is much simpler than the "lead and follow" controls needed to bring smaller machines in as needed.

Air systems have their capacity too. Don't try to squeeze too much air through pipes that were put in long ago. Maybe a compressor out in the plant will take care of one department. Scattering compressors around the plant makes them hard to supervise and maintain, but it may be the solution before considering a whole new plant air system.

If you're adding capacity to relieve an overworked compressor, consider doubling your available cfm, so you can use the present compressor as a standby. Its age will affect your thinking. Ask yourself how many years it has left. In several of the applications shown on these pages, a new compressor was installed as a basic unit with the older machines standing by most of the time and providing only peak requirements.

WHAT TYPE COMPRESSOR?

When you get down to actual hardware on this project, the only people to give you specific information are representatives of compressor manufacturers. The specification charts in this report will tell you generally what each company makes. From there it's a matter of narrowing down your choice according to design, delivery, price, and make of present compressors.

Three important design features you should look into are the compressor's cooling by air or water, how many stages it has, and its capacity control. Much of an air compressor's design is to get rid of heat. How well it does this plays a big part in its efficiency. It takes 36% more power to compress air to 100 psi without removing heat (adiabatically) than if heat is removed as fast as its generated (isothermally). Compressors work somewhere between these two extremes.

When air is compressed in more than one stage, it can be intercooled between stages, and this gives higher efficiency. On smaller compressors the intercooler may be only a length of finned tubing. On larger machines it will probably be a shell-and-tube, water cooled heat exchanger, or fan-cooled radiator through which the air passes.

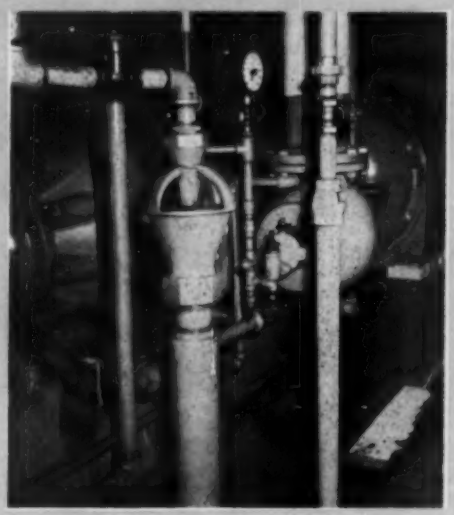
If you're considering using cooling water, do some figuring on how much it will cost. It may pay you to recirculate it through a cooling tower rather than pour it down the sewer when it's done its job. Some plants tie in this water with their fire protection system, let it keep a cistern full.

Usually a compressor delivers into a storage tank. Once it's got the tank up to pressure, there's no need for air, and the compressor must either stop or be unloaded. Smaller compressors may be controlled by a pressure switch with contacts in the motor starter circuit. When air pressure reaches the pressure switch setting, the motor and compressor stop until pressure drops about 20%.

Where this pressure range is unsuitable, or where it is not practical to start and stop the motor, the

Motor's duty cycle

Using motion-time-study information, General Electric Vacuum Sweeper Div. knows just how much additional air it will need for expansion. Two 15-year old, 1041-cfm, 200-hp compressors were supplying the plant when a production increase added 200 cfm to the requirements. Foreseeing another expansion still to come that would take an additional 300 cfm, plant engineers decided to bring total capacity to about 3500 cfm. They initially settled on a 1450-cfm unit driven by a 300-hp motor (actual horsepower requirement is 291). The next size in the rotary vane type compressor was a 1650-cfm



Select pressure

System pressure at Metal Seal & Products Co. ranges between 150 to 175 psi. They need the higher pressure for air-operated clamps on a press. A valve on the compressor selects either suction valve unloading to hold pressure between 145 and 155 psi, or pressure switch control to stop the motor at 175 psi.

When Irving and Edmund Diemer started this job-shop machining operation, they had a 1½hp compressor to supply index tables, drill press feeds, clamps, and bar stock feeds. They quickly replaced that with a 5-hp unit, as they increased production and added machines. Recently they doubled capacity with the installation of this 10-hp compressor.

Their bar feeds are especially sensitive to moisture, so they've taken care to get dry air. A shell-and-tube aftercooler condenses out most of the moisture. Before they had it, they used to remove about ½ pint of water a day from filters at the feeds. With the aftercooler, there's only a couple of spoonfuls a week.

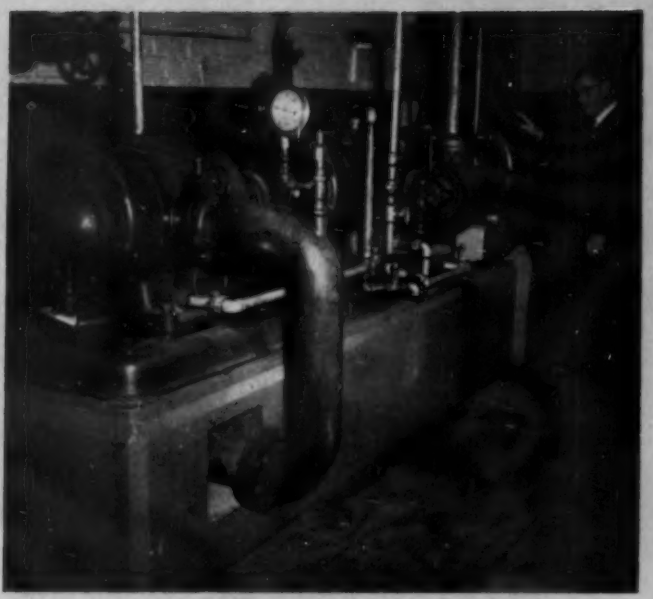
The system was piped up with copper tubing for a fast, tight installation.

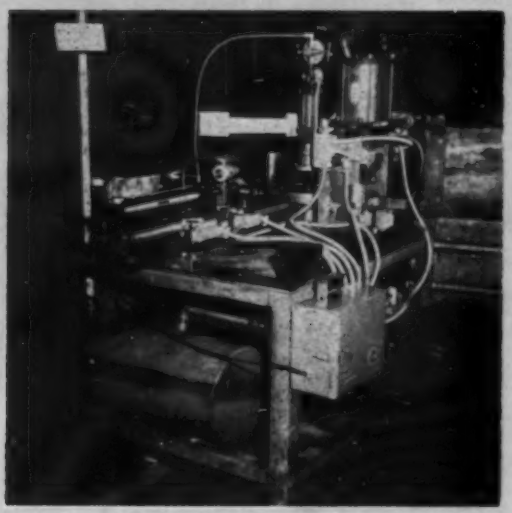
permits larger compressor

unit which requires 329 hp fully loaded but can still take a 300-hp motor for the intended service. For only 4% more they got a compressor delivering 200 cfm extra and occupying the same amount of floor space. The new compressor now carries the base load, the smaller units are cut in only when needed.

Typical of air requirements in this high production appliance plant is the piercing machine (below) for a sweeper's sheet metal air chamber.

Close-up of the compressor (left) shows its unloading mechanism.





to suit the job

compressor may have pressure-actuated controls to hold its suction valves open, so that it cannot compress air. Pressure varies about 10% with this type of unloading control.

Large compressors, usually above 75 hp, have pressure-actuated step control, so that they unload in steps according to air requirements. Three-step control gives compressor outputs of full, half, and zero. Five-step control, usually on compressors over 150 hp, gives full, three-quarters, half, one-quarter, and zero deliveries.

If you can drive the compressor with a steam turbine or engine, you have the advantage of speed control. Since a compressor's delivery depends on its speed, controlling the steam throttle according to air pressure matches compressor power input exactly to requirements and gives efficient operation.

SYNCHRONOUS OR INDUCTION MOTORS?

What kind of motor you use to drive the compressor depends mostly on power requirements. By the time you buy the d-c exciter and motor-starting equipment for a synchronous motor, it usually costs more than a comparable induction motor, especialily below 200-250 hp. However, the big advantage of the synchronous motor is lower cost operation, because of better power factor and higher speed.

HOW ONE COMPANY COMPARED 250-HP SYNCHRONOUS AND INDUCTION MOTORS.

	Synchronous	Induction
Initial cost	$ 590 less	
Efficiency—% Full load	92.8	90.7
¾ load	91.8	90.5
½ load	89.7	88.6
Full load speed—rpm	514	505
Compressor delivery—cfm	1395	1370
Full load current—amp	27.9	34.8
Full load power factor	1.0	.82
Full load power input—kw	207	210
D-c excitation input—kw	3	—
Average power input—kw	160	166
Power cost/hr	$ 1.60	$ 1.66
Power cost/month (18-hr day, 22-day month) a-c	$ 634	$ 658
d-c	$ 11	—
Total power cost/month	$ 645	$ 658
Maintenance time—hrs/mo		
Slip rings	14	—
Clean d-c windings	36	—
Replace brushes	4	—
Total maintenance time — hrs	54	—

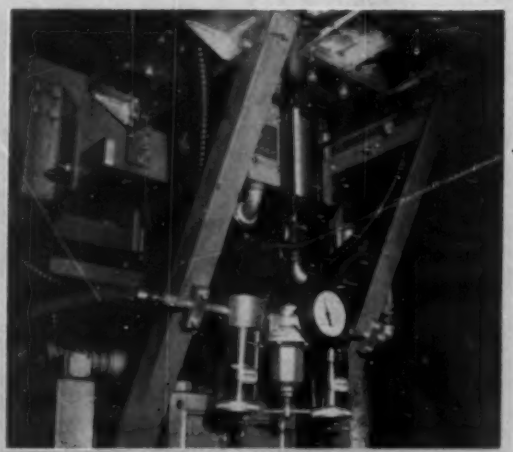
Maintenance puts a different color on the picture. Synchronous motors have d-c commutators which have to be cleaned, and brushes which have to be replaced. D-c windings have to be cleaned to prevent overheating.

All things considered, some plant men prefer induction motors, even where there's a need for power factor correction. They figure they can do it by adding capacitors and still have the relatively maintenance-free

Where there's

Solenoid valve

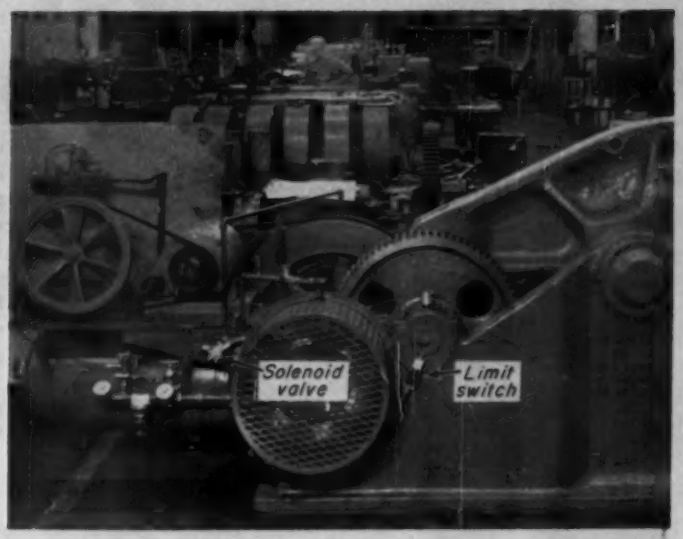
This 20-hp compressor delivers through a 10-ft shell-and-tube aftercooler to a tank. Water flow through the aftercooler is controlled by a solenoid valve that is actuated when the compressor cuts in. A pressure switch controls both the compressor motor and the solenoid valve, holding pressure between 125 and 150 psi, and insuring that aftercooler water flows only when needed. Air temperature into the aftercooler is about 185 F. With water flowing coun-



no air supply, mount the compressor on the machine

Air operates the clutch and brake on this shear. It's used in scrap operations in steel mills where there's seldom plant air available. So Hill-Acme mounts a compressor on the machine and drives it from the same motor that drives the machine's fly wheel. The compressor takes 1½ hp to deliver 7.2 cfm at 690 rpm. The clutch-brake duty cycle is about 5 cycles/min. Each cycle takes 0.4 cu ft of air on the smallest shear, 1.2 cu ft on the largest. The main drive motor ranges from 5 to 15 hp according to shear size.

The shear is usually operated by a foot switch which actuates a solenoid valve. This connects air to the clutch and exhausts it from the brake. When the foot switch is released, the valve remains energized until a limit switch is actuated at the shear's full open position. This de-energizes the valve, applying pressure air to the brake and releasing it from the clutch. The air pressure regulator is set for 75 psi.

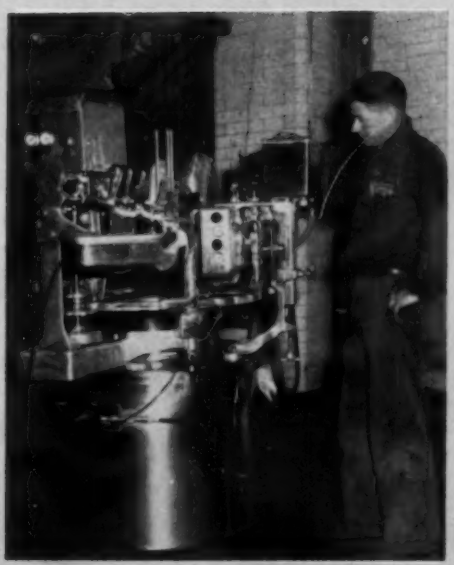


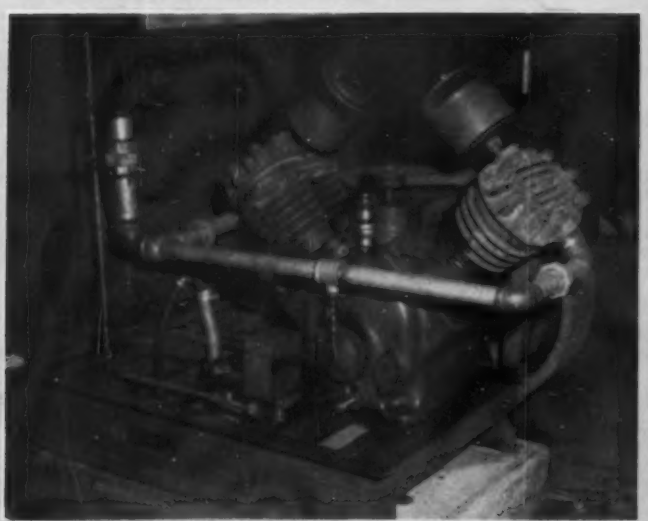
This compact packaging machine made by Pak-All has its own 75-psi compressor. It's an oil-free unit with aftercooler, pulsation chamber, and moisture separator combined into a single unit. The 2-in. cylinder operates heated bars which cut off each package when an exhaust valve is actuated. This operates the directional valve mounted on the cylinder.

saves aftercooler water

tee to the air, to avoid thermal shock, air leaves the aftercooler at 55 F in the winter, 65 F in the summer.

Typical of the air-operated equipment in Sealtest's ice cream plant, where this compressor is installed, are the cylinder mechanism for packaging Eskimo Pies, and a new Choco-Jet machine shown by T. R. Turner. Its five air cylinders turn out 65 of these ice cream delights a minute.





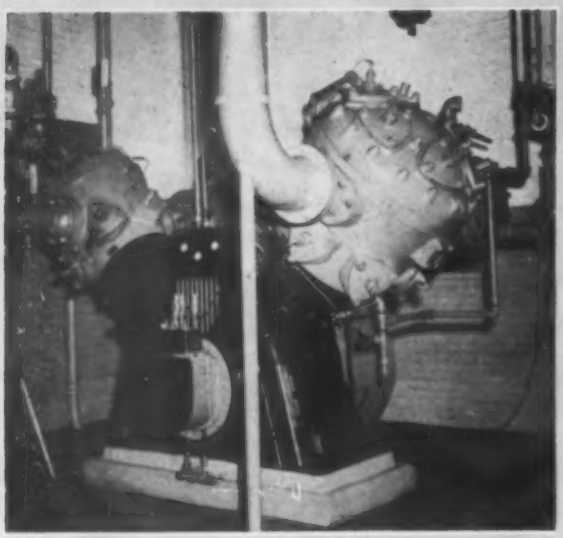
induction motor at a lower initial equipment cost.

Don't forget the possibility of driving with a steam turbine or engine, if your plant uses steam for heating or other processes. You may be able to use the exhaust from a steam compressor drive. It could save you a lot in electrical power costs.

In a midwest cutting tool plant, they compared the two motor types carefully, finally decided on a 250-hp induction type. Two special reasons that swayed their thinking: no need for power factor correction, a voltage supply of 4160 v. The comparative figures they worked out are tabulated above. Although the synchronous motor would cost about $150 less to operate for a year (and would cost less initially because they already had the exciter) estimated maintenance costs more than offset the operating savings. Not counted in: cost of replacement parts, losses due to decreased production, higher supervision for the synchronous motor.

Pressure dropped 20 psi

2600 cfm from their compressors wasn't enough for Grabler Mfg. Co. System pressure dropped from a normal 105 psi to only 85 psi during full operation. This new, 800-cfm compressor brings their capacity to 3100 cfm for their foundry operations. One of the many protective devices is an over-temperature switch in the compressor outlet.



AUXILIARY EQUIPMENT YOU'LL NEED

First step in compressing air is a filter for the compressor inlet. Its size depends on pulsations in compressor operation, as well as compressor capacity. It has to handle the highest inlet air velocity, and special formulas have been worked out by the air-filter manufacturers to make sure you get a filter big enough. When compressors unload through intake valves, they need a relief valve to prevent reverse air flow from blowing out oil in the filter.

Filters fall into three types: dry, oil-bath, and oil-wetted. The dry type gives finest filtration. It can have either a throw-away element or a cleanable one. Don't use it in a moist or oily atmosphere, because it will gum up. Oil-bath filters have the greatest dirt-holding capacity, about a pound of dirt per pint of oil. Oil-wetted filters have the lowest cost, but are least effective in stopping fine particles. They can hold more dirt than the dry type, but not as much as the oil-bath type.

Combining a silencer with the filter is often good public relations. Especially where the compressor intake is outside a building, it can be mighty annoying to the neighbors in the still of the night.

Put the air intake in as cool and clean a place as possible. Keep it away from steam exhausts, paint sprays and other contamination. If you put it outside, make sure it's protected from rain and snow.

The aftercooler which cools air out of the compressor is sized according to compressor capacity. It should be installed as close to the compressor as possible and connected by a short, straight pipe run. As air leaves the aftercooler, condensed moisture is collected by a separator which usually works on either a centrifugal or baffle principle. This water may be collected in a trap which has a float valve to drain the water.

Separators which may incorporate filters are also installed at other points in the system: at the com-

pressor inlet, between compressor stages, downstream of the receiver, and at points in the air distribution system.

Dryers take moisture out of the air with an absorbent chemical. They are frequently installed after the receiver, and they may eliminate the need for an aftercooler.

Last stop before the air goes to work in the plant is the storage tank. You can calculate its size from the compressor delivery and its compression ratio:

$$\text{Receiver size} = \frac{\text{Compressor CFM}}{\text{Pressure Ratio}}$$

$$\text{Pressure Ratio} = \frac{\text{Discharge Pressure (absolute)}}{\text{Inlet Pressure (absolute)}}$$

Size it on the large side rather than too small. You'll never be sorry with the extra volume, because in addition to being able to accommodate added capacity, it will slow down air velocity for further moisture condensation. If you install the tank horizontally, be sure to tilt it, and put in a valve at the low point to permit blowing out moisture. An automatic drain valve will keep the tank free of moisture.

NOW PROTECT IT ALL

Once having made this expensive installation, there are many devices you can use to protect it and insure continuous operation. Relief valves should be connected at the intercooler and receiver, and a relief valve should be installed between the compressor and the first shut-off valve.

Thermal shutdown devices can be used to monitor bearings and discharge air. Overspeed protection is usually standard equipment on steam drives. Lubricating oil pressure should be monitored to shut down the machine if oil pressure gets too high or too low.

Thermometers will tell you a lot about what's happening in your compressed air plant. One at the tank indicates how well you are using its capacity to store air. The hotter the air, the less weight you are storing.

A thermometer at the aftercooler outlet indicates good operation if it shows 10-15 degrees above inlet water temperature.

A high temperature shutdown device is worthwhile protection. It senses compressor exhaust temperature and stops the motor when this air gets too hot. That probably means trouble in the lubricating system or the water cooling system. To save water, the compressor and/or aftercooler may have a water temperature control. This senses outlet air temperature and regulates water supply accordingly. ▼▼▼

JIC PNEUMATIC STANDARDS FOR INDUSTRIAL EQUIPMENT

A3 Compressors

A3.3—MOUNTING OF COMPRESSORS

A3.3.1 Compressors, or subassemblies including the compressors, shall be readily accessible for maintenance.

A3.3.2 Compressors shall be mounted where they are adequately protected from damage.

A3.3.3 When compressors and other apparatus are mounted inside a compartment or enclosure, sufficient space shall be provided to assure complete accessibility to all units.

A3.3.4 (A) Compressor compartments shall be clean, free of moisture and adequately vented. All openings shall be of sufficient height above the floor or be protected to such an extent that dirt, chips, coolant, etc., cannot enter, including such times as floor is swept or washed or the equipment is cleaned.
(B) If piping is run into the compressor compartment from another compartment not meeting the compressor compartment requirements, adequate seals shall be provided.

A3.3.5 Direct-coupled compressors shall be properly aligned and securely mounted in such a manner as to assure alignment under normal operating conditions. When mounted inside column or base of equipment, foot-mounted compressors and driving motors shall be mounted on a sub-base of adequate strength which can be easily removed for servicing. The coupling shall have adequate capacity to transmit the power required.

A3.3.6 Where compressors are piped in parallel, appropriate valves shall be provided to permit the removal of any compressor while other compressors are still in operation.

A3.5—COMPRESSOR NAMEPLATES

A3.5.1 The following information shall be permanently indicated on each compressor:
(A) Manufacturer's name and address.
(B) Manufacturer's identifying part number.
(C) Manufacturers serial number if any.
A data sheet or catalog providing complete information on speed limits, pressure range, delivery and horsepower required shall be provided with the specifications.

A3.5.2 Whenever a compressor is mounted so that its nameplate is not readily visible, a plate with duplicate information shall be provided where it can be readily seen. Such duplicate plate shall be marked "DUPLICATE." The namepate shall not be removed from the compressor.

A3.5.3 The direction of rotation of each compressor shall be clearly indicated on the compressor or flywheel where it can be readily seen.

Oversized fluid motors give speed control

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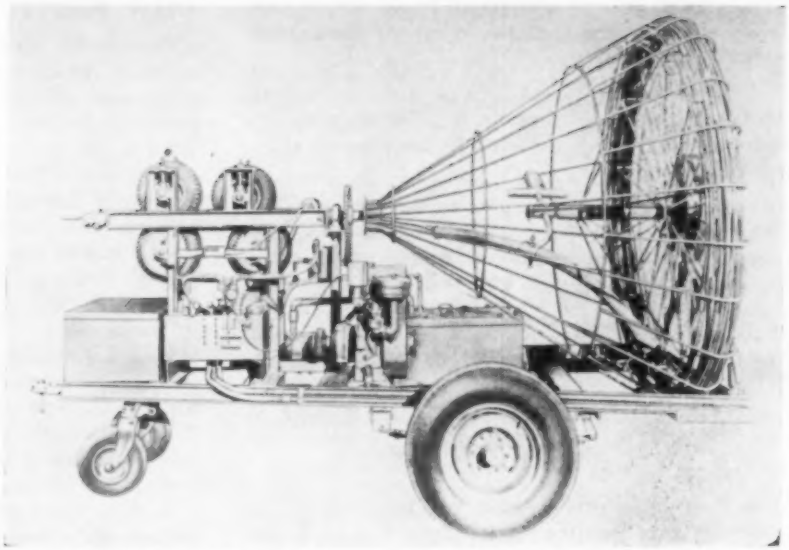
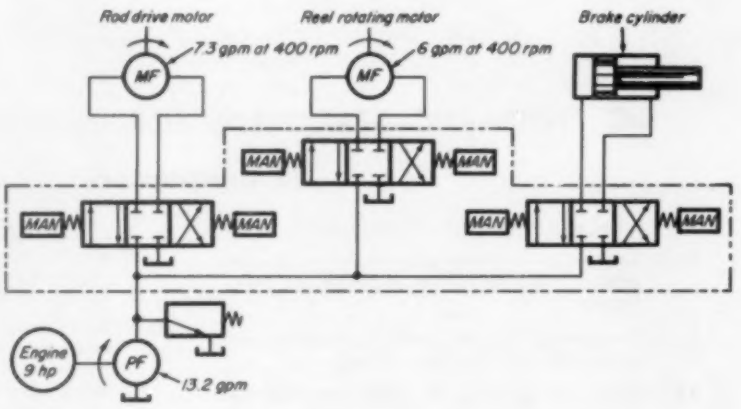


MOBILE SEWER CLEANER carries its own power pack. A gasoline engine drives the pump which supplies oil to two hydraulic motors. One rotates the pneumatic tires (top left) that work the rotating rod in and out of the sewer. The other motor turns the reel which stores the cleaning rods.



OVERSIZED HYDRAULIC MOTORS speed up and slow down automatically as the load dictates. Either motor will pass full pump output. When the cutter hits an obstruction, its drive motor slows down or stops. When this happens, flow to the reel drive motor increases and the cutter turns faster until the obstruction is removed.

THE *Hydrodder* pushes, pulls, and rotates the rods used in sewer cleaning. Its cutter automatically rotates faster when it hits an obstruction.

The unusual circuit idea: it has two fluid motors, sized so that full pump capacity can pass through either motor. One of the motors turns the pneumatic wheels that push and pull the rod. The other rotates the rod and reel, through a chain and sprocket.

When the rod meets an obstruction, the pushing motor slows or stops. Then the rotating motor gets more fluid and speeds up. When the cutter passes the obstruction, the motors return to their original speeds.

The hydraulic power pack consists of a vane pump driven by a 9-hp. gasoline engine. The pump delivers 13.2 gpm at pressures to 1000 psi. An adjustable relief valve limits fluid motor torque.

A double-acting cylinder actuates a brake band assembly to stop the reel quickly. This cylinder is controlled by a manual 4-way valve.

The hydraulic drive has many advantages over driving directly from the gasoline engine. Shock loads on rods, tools, and engine are less. Torque can be increased or decreased without changing engine speed. The total weight of the power supply is less.▼▼▼

Pulsations in positive displacement pump flow

• By **WARREN E. WILSON,** *Chairman Department of Engineering*
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This analysis shows the cause of flow pulsation in positive displacement pumps and tells how to control it.

THREE factors cause pulsations in positive displacement pump flow.

- Pulsations occur if the enclosed fluid volume is not decreased at a constant rate. In a piston pump, the enclosed volume is a function of time or angular shaft displacement, so flow is also a function of time.
- Gas pockets caused by inlet flow restriction cause flow pulsations. Discharge pressure drops quickly when a gas pocket enters the high pressure region.
- If back flow (slip) from the pump's high pressure side to its low pressure side is not constant, there will be pulsations.

• **Evaluation of pumps**—Pumps can be designed for pulsationless flow. One requirement for vane pumps is that the vanes also act as pistons to pump fluid. They must be submerged in the liquid and not separating liquid in the pumping chamber from liquid behind or below the vanes.

• **Vane pump analysis**—Figure 1 shows the discharge port region of a vane pump. The space bounded by curved surface cd, radial plane de, curved rotor surface ef and radial plane fc, all of width b, is fixed in space and of constant volume.

PUMP TERMS

POSITIVE DISPLACEMENT—*Pumping action by decreasing volume enclosing fluid.*

CAVITATION—*Failure to fill pumping enclosure*

SLIP FLOW—*Flow from high pressure to low pressure through clearances between moving and stationary pump elements.*

Flow into this volume across the radial surface cf consists of liquid and metal and is constant at the rate $Q_1 = Hbr_1\omega$. The flow of liquid from behind the vane out of the vane pocket, Q_2 is equal to the flow of metal, Q_3 into the vane pocket.

$$Q_2 = sb\frac{dh}{dt}$$

Flow Q_4 across radial plane surface de is

$$Q_4 = mbr_2\omega$$

Net liquid discharge, Q_5, can be computed from the continuity equation:

$$Q_1 + Q_2 - Q_3 - Q_4 - Q_5 = 0$$

or

$$Q_5 = Q_1 + Q_2 - Q_3 - Q_4$$

If m is very small compared to H, we may neglect Q_4. Also, since

$$Q_2 = Q_3$$
$$Q_5 = Q_1 = Hbr_1\omega$$

If ω is constant, and distances H, b, r_1 are also constant, discharge Q_5 will be constant and free of pulsation.

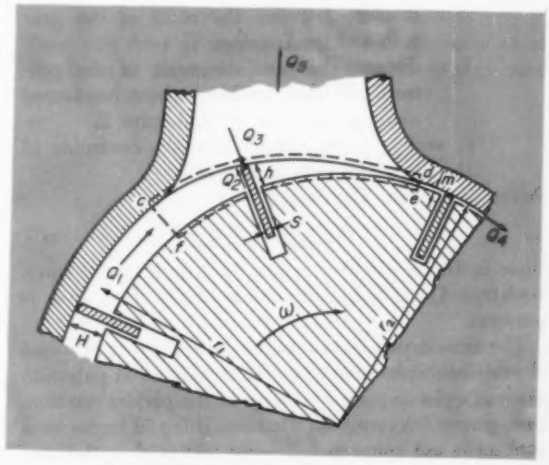


FIG. 1. COMMON VANE PUMP delivery analysis.

If liquid in the vane pocket is not forced out into space cdef we have

$$Q_3 = Q_1 - Q_2$$

$$Q_2 = sb\frac{dh}{dt}$$

$$\omega = \frac{d\theta}{dt}$$

$$Q_3 = sb\omega\frac{dh}{d\theta}$$

$$Q_3 = Hbr_1\omega - sb\omega\frac{dh}{d\theta}$$

$$\frac{dh}{}$$

In this case, both ω and $d\theta$ must be constant for no pulsation. This limits the geometry of curve cd. In fact, it is impossible to have tangent contacts at c and

$$\frac{dh}{}$$

d and a curve shape to make $d\theta$ constant. Some compromise is necessary in this type of pump: either some pulsation or a discontinuity in the curve at the end points.

• **Gear pump analysis**—In the gear pump shown in Figure 2, the control space cdefghjk is fixed in space and of constant volume. Flow into the space, Q_1, consists of metal and liquid on each side, or a total of $2Q_1$. Flow out is Q_2 into the discharge port, and Q_3 between the gears to the intake area. Flow Q_2 is entirely liquid. Q_3 is both liquid and metal. Because the control space has constant volume:

$$2Q_1 - Q_3 - Q_2 = 0$$

$$Q_3 = 2Q_1 - Q_2$$

In terms of pump geometry:

$$Q_1 = Hr_1b\,\omega$$

$$Q_2 = hr_2b\,\omega$$

where:

ω = the angular gear speed

b = gear width perpendicular to the section shown

H = distance between the roots of the gear teeth and the housing.

h = distance between the roots of the gear teeth at the meshing point measured along radial line hg in Figure 2.

r_1 and r_2 = the distances to the centroids of the areas Hb and hb respectively.

Pump discharge, Q_2, is:

$$Q_2 = 2Hr_1b\,\omega - hr_2b\omega$$

$$= b\omega\,(2Hr_1 - hr_2)$$

Since h, H, r_1, r_2 are constant for a well made pump, discharge Q_2 is constant and pulsation free if ω is constant.

The same type of analysis can be applied to all types of positive displacement pumps. It shows that pulsation occurs in piston pumps because of the pistons' motion. Vane pump delivery has pulsations if liquid in the vane pockets is not connected directly to liquid in the control space but not from geometric or kinematic causes.

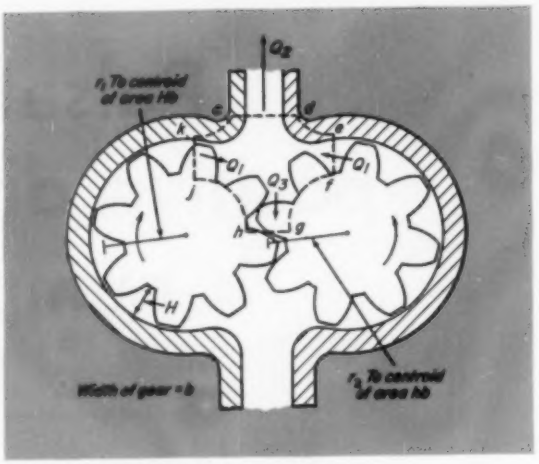


FIG. 2. GEAR PUMP delivery analysis.

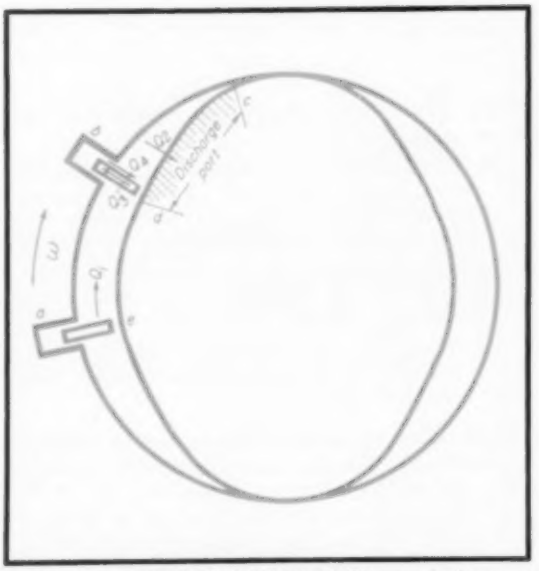
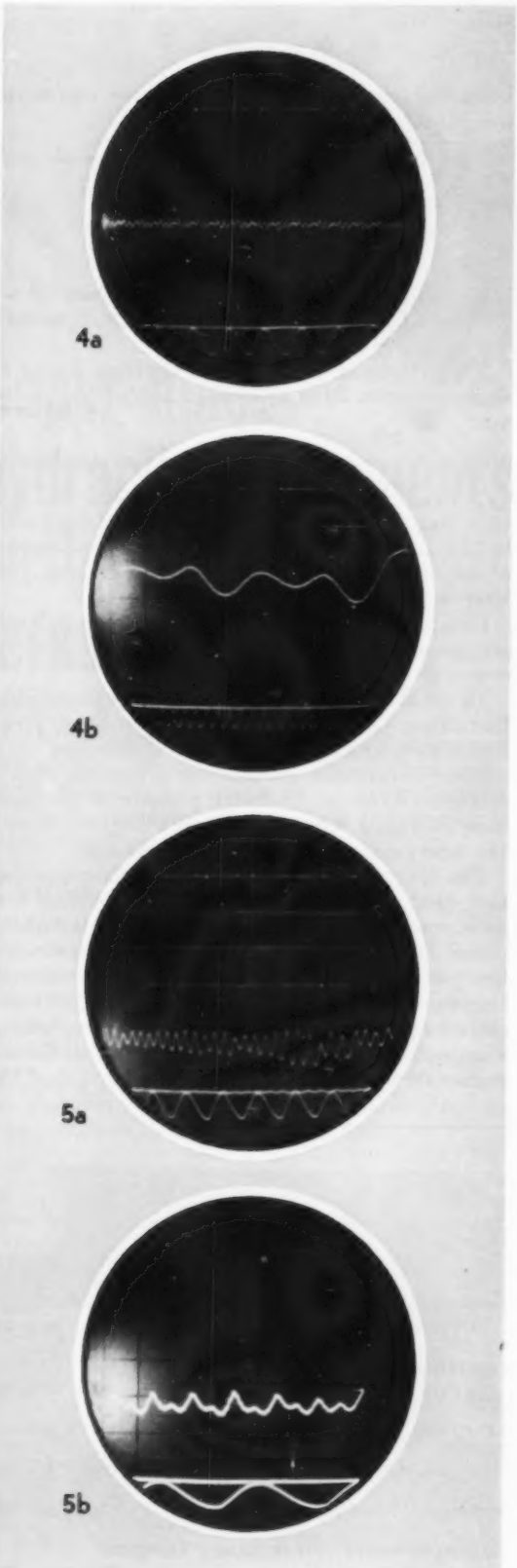


FIG. 3. CYLINDRICAL HOUSING holds vanes in this pump design.

FIG. 4. PRESSURE FLUCTUATIONS in an internal gear pump (a) and a vane pump (b). Vertical scale in (a) is 50 psi per division. Discharge pressure is 160 psi. Trace frequency is 100 cps. Vertical scale in (b) is 60 psi per division. Discharge pressure is 200 psi. Trace frequency is 3000 cps.

FIG. 5. EFFECT OF CAVITATION on pump discharge pressure. (a) shows internal gear pump (b) vane pump. Inlet vacuum is 20" Hg for each. Discharge pressure for each is 80 psi. Vertical scales of oscillograph trace is 50 psi per division and trace frequency is 100 cps for each.



• **New vane pump design**—A special vane pump has its stator and rotor reversed.

Figure 3 shows such a pump with a non-cylindrical rotor. The surrounding housing is cylindrical and houses the vanes. Discharge and inlet passages are in the rotor. To simplify analysis, consider the rotor fixed and the housing rotating. Flows to and from fixed volume a e c are inlet Q_1, discharge Q_2, vane volume moving outward, Q_3, and fluid flow inward from below the vane, Q_4.

Then

$$Q_1 - Q_3 - Q_2 + Q_4 = 0$$

Q_1 is constant. Q_3 and Q_4 depend on rotor contour. Q_2 is the result of the entire process.

$$Q_2 = Q_1 - Q_3 + Q_4$$

Since

$$Q_2 = Q_4$$
$$Q_3 = Q_1$$

Hence there is no pulsation in the delivery.
If the vanes do not pump,

$$Q_4 = 0$$
$$Q_3 = Q_1 - Q_2$$

Again, the shape of surface ec determines flow Q_3 and there will be pulsation unless the radial distance to the surface ec is a linear function of angular displacement. Tangency is a problem again.

Having established pulsation characteristics of positive displacement pumps due to geometric and kinematic causes, we can now consider effect of slip flow and cavitation. These necessarily account for much of the pulsation in positive displacement pump discharge.

• **Slip effects**—A pump's slip flow, Q_s is described by:

$$\Delta Q_s = \frac{\Delta p \; b \; h^3}{12 \mu l}$$

Where:

Δp = pressure difference across pump
h = clearance
l = length of slip flow path
μ = fluid viscosity
b = width of slip flow path
ΔQ_s = slip flow of a single slip passage in the pump

Total slip flow at any instant, Q_s, is the sum of all slip flows at the surface contacts separating high pressure from low pressure areas:
or

$$Q_s = \Sigma \, \Delta \, Q_s$$
$$Q_s = \frac{\Delta p}{12 \mu} \Sigma \frac{h^3 b}{l}$$

Pump delivery at any instant is

$$Q = DN - \frac{\Delta p}{12 \mu} \Sigma \frac{h^3 b}{l}$$

where

D = displacement per revolution
N = number of revolutions per second.

If the pump is in a system consisting of pump and flow control valve, and flow through the valve is laminar

$$Q = K \, \Delta p$$

Combining equations

$$DN - \frac{\Delta p}{12\mu} \Sigma \frac{h^3 b}{l} = K \Delta p$$

Solving for Δp:

$$\Delta p = \frac{DN}{K + \frac{1}{12\mu} \Sigma \frac{h^3 b}{l}}$$

To simplify, let:

$$a = \frac{1}{12\mu}$$

$$x = \Sigma \frac{h^3 b}{l}$$

Then:

$$\Delta p = \frac{DN}{K + ax}$$

Changing clearance h changes x. Differentiating with respect to x:

$$\frac{d(\Delta p)}{dx} = \frac{-DNa}{(K + ax)^2}$$

$$= \frac{-\Delta p\, a}{K + ax}$$

$$= \frac{-\Delta p^2 a}{DN}$$

or

$$d(\Delta p) = \frac{-\Delta p^2 a dx}{DN}$$

A fluctuation in pressure drop, d (Δp) will be directly proportional to a change, dx, in the quantity x. It will be proportional to the square of Δp and inversely proportional to DN.

This fluctuation in pressure is unacceptable if quantity $\Sigma \frac{h^3 b}{l}$ varies even slightly during one revolution.

Since:

$$Q_s = \Delta p\, ax$$

$$d(Q_s) = \Delta p\, a\, dx$$

Using this relationship and the previous expression for $\frac{d(\Delta p)}{dx}$

$$\frac{d(\Delta p)}{\Delta p} = -\frac{d Q_s}{Q_t}$$

where:

Q_t = ideal delivery, DN.

The ratio of fluctuation in pressure differential to pressure differential itself, equals the ratio of fluctuation in the slip to ideal flow.

If the maximum and minimum clearance during a single revolution differ by as much as 5%, the quantities $x = \Sigma \frac{h^3 b}{l}$ and Q_s will differ by approximately 15%. As a result, the pressure fluctuation d (Δp) will be 15% of the pressure drop Δp. Even a 1% variation of the clearance will introduce a 3% fluctuation. At 1000 psi this would be 30 psi.

Figure 4a shows pressure fluctuation in an internal gear pump. The fluctuations are about 6%. This is acceptable for most applications.

Figure 4b shows performance of a vane pump with fluctuations of about 40% of mean discharge pressure. This is unacceptable for most applications.

Effect of cavitation on discharge pressure is shown in Figure 5. In (a) discharge pressure of the gear pump of Figure 4 is compared with the vane pump. The vane pump shows superior performance.

The comparison of the two pumps illustrates the analysis above. When operating at high pressures, the vane pump has a very undesirable slip characteristic caused by differences in clearances in the various flow paths. The gear pump shows no such weakness. However, the vane pump has a good cavitation characteristic because of a special intake design, whereas the gear pump suffers from the usual limitations at the inlet. ▼▼▼

Recent Articles on Pump Design and Application

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By R. J. Murphy — Dec. '59 p. 92

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By Walter Ernst — Nov. '59 p. 76

CIRCUIT CHANGES PREVENT HUNTING OF COMPENSATED PUMP
By John P. Sharp and John P. Snyder — Aug. '59 p. 73

HOW TO MATCH POWER REQUIREMENTS
By Elmer F. Heiser — Aug. '59 p. 80

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HYDRAULIC PUMP SELECTION — Apr. '58 p. 79

MATCHING PUMPS TO FREQUENCY RESPONSE
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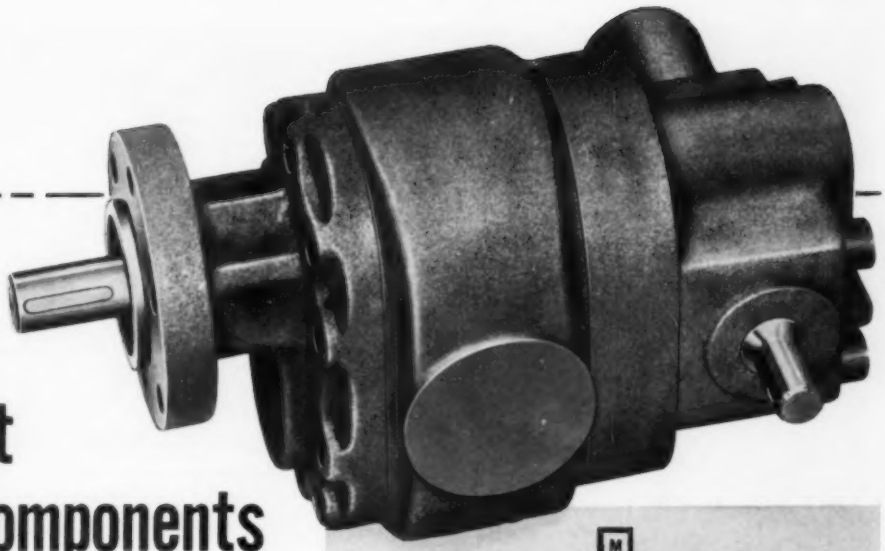


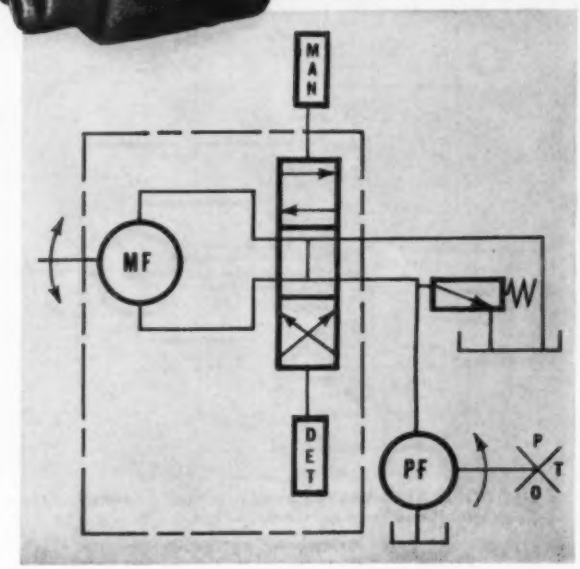
Super quiet hydraulic components hush unique refuse loader

A Model H hydraulic pump generates the fluid power which energizes the motor and all the cylinders on this continuous loading and compacting refuse collector—the Roto-Pac produced by City Tank Corporation of Corona, New York.

80 decibels of sound

Municipal specifications demanded a quiet-running pump—maximum noise level 80 decibels when measured 34 inches from source. COMMERCIAL's Model H Pump meets this requirement handily and delivers constant volume at over 90% efficiency. The reason: precision-ground matched helical gears, oversize bearings, protected leak proof seals and patented thrust plates team up to maintain positive internal alignment—prevent seizing—dampen shock and reduce noise.

ROTO-PAC'S continuous loading and tighter compaction results in ⅓ more payload—cuts collection costs.



100% Hydraulic... 100% COMMERCIAL

COMMERCIAL produces all of the fluid power components used to operate the Roto-Pac... the pump, valves, cylinders and motor. Drive for the escalator and rotary continuous-compaction plate is with the Model D hydraulic motor shown above with its corresponding J.I.C. symbolic circuit. Note how this motor and its control valve are built... two components combined into a single unit. Result: less mounting space required—less installation cost.

Engineering experience available

Personal technical service and assistance on fluid power applications is yours for the asking. Send today for your copy of Bulletin 100-P4. Address inquiries to Commercial Shearing & Stamping Company, Dept. A-10, Youngstown 1, Ohio.

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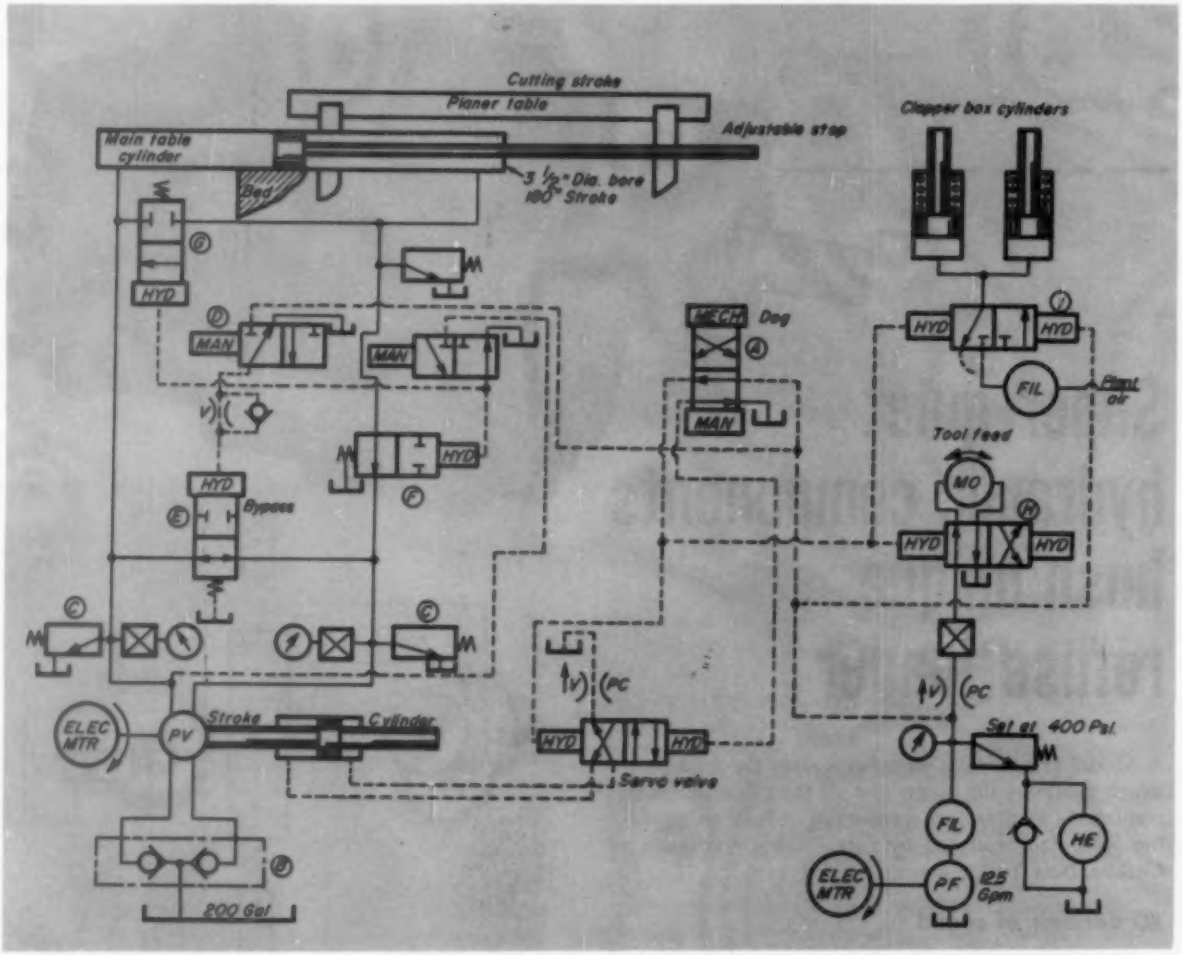


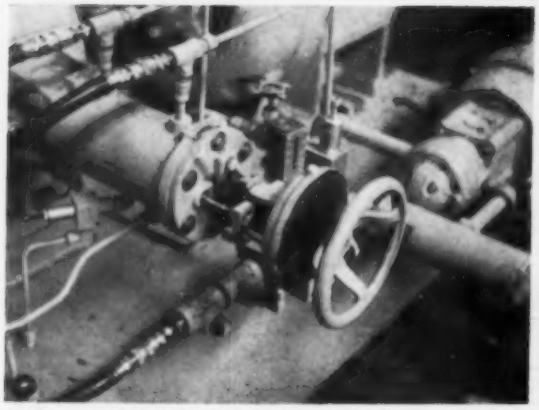
PILOT-OPERATED VALVES coordinate table movement, clapper box, and tool feeding functions of the planer drive. Second speed range is obtained from differential circuit.

Planer's differential circuit is automatically sequenced

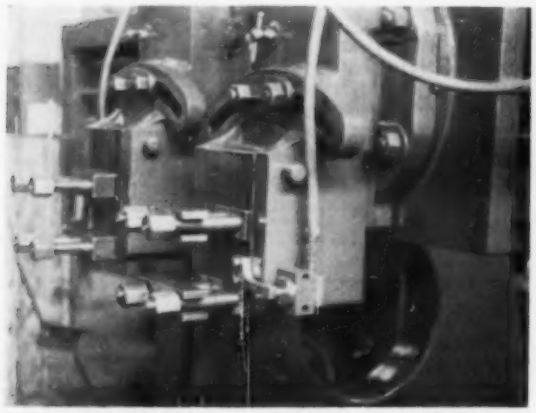
• By **ROBERT PFITZENMEIER,** *Sales Engineer, The Airoyal Co., Maplewood, N. J.*

Two-speed hydraulic drive uses differential circuit on the cutting stroke. Dual-directional pump is stroked by a variable-travel cylinder.

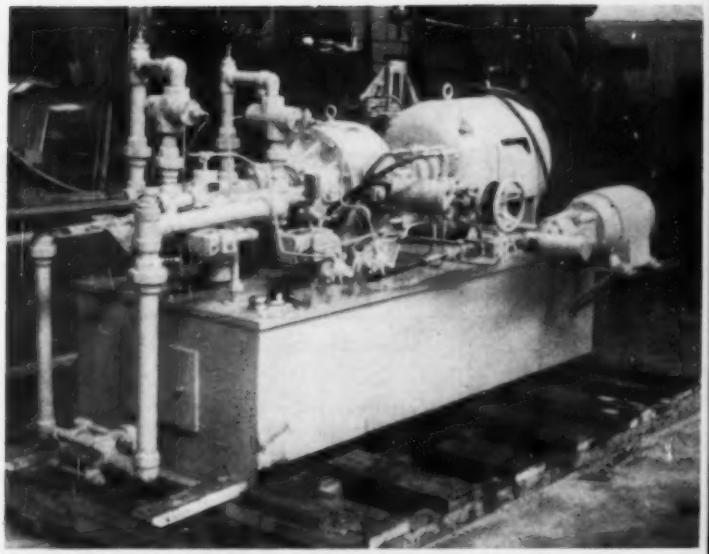
CONVERSION of this planer to hydraulics required not only increased table speed, but two speed ranges for different load situations. A differential circuit is incorporated into the system to operate when the planer needs the higher speed range. The planer has three synchronous motions; table stroke, tool feed, and clapper box raising.



PUMP STROKING CYLINDER with integral servo valve and handwheel controls the pump output and direction of discharge. Planetary gears assure fine cutting speed adjustment.



AIR CYLINDERS lift the clapper box and tools off the work at the end of each planing stroke. Plant air is used for this.



HYDRAULIC CONVERSION PACKAGE. Motors, pumps, valves, and controls are grouped on a 200-gallon reservoir. The unit is installed next to the planer.

• **Table circuit**—The table is stroked by a double-acting cylinder (3½" bore x 180" stroke) with a 2½" diameter rod, prestressed to avoid sagging of its own weight. The cylinder is installed in the planer bed with the rod attached to the table. Adjustable stops on the table limit its travel.

Due to size and performance, this cylinder is designed especially for this job. For smaller planers with strokes up to 9 feet, a standard cylinder with a 2:1 rod will suffice. With strokes over 15 feet, double-acting, single rod cylinders are not recommended due to column action on the rod. Multiple single-acting, or a double-acting, double rod cylinder with a tension cylinder can be used for these longer strokes.

At the end of a stroke, the adjustable stop contacts a dog which operates a rotary 4-way valve *A*. This valve is connected to a small, constant displacement pump with a 12.5-gpm output at 400 psi. The pump provides pilot pressure to control table shuttling as well as auxiliary valving. Since the output of this pump is used only at the end of each planer stroke, most of its output flows through a relief valve and is converted to heat. This flow is diverted through a heat exchanger before returning to tank, so that the maximum oil temperature is 110°F.

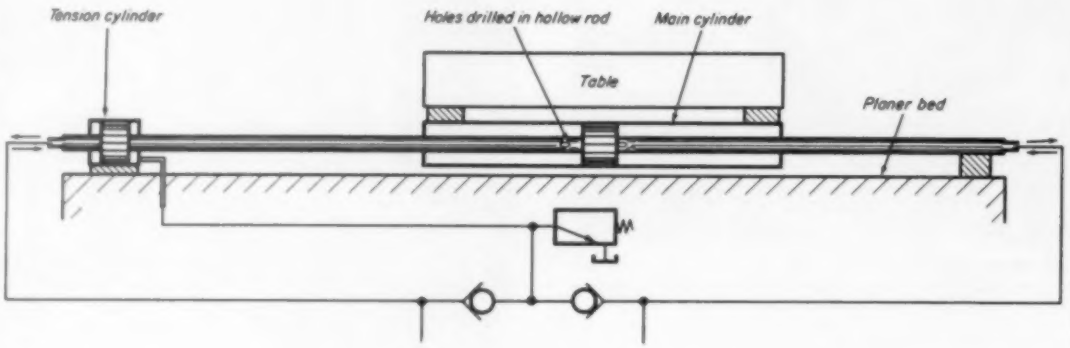
Pilot fluid is channelled to ports of a servo valve mounted on a pump stroking cylinder. A planetary geared handwheel selects a stop for a sliding four-land spool which reciprocates inside the cylinder. Thus the handwheel controls cutting speed, while positioning the servo cylinder which actuates the main pump stroking cylinder.

A radial piston, dual-directional, 30-hp pump powers the table cylinder. With an output to 44 gpm at 1500 psi, the pump's suction and discharge ports are reversible, eliminating the need for a directional valve, and providing smooth and adjustable table acceleration control.

The pump inlet ports connect to a differential

Concluded on next page

WHAT IS A TENSION CYLINDER?



A tension cylinder has short stroke (½ to 1"), with a diameter slightly larger than the main cylinder. It is used to keep the rod of a double-acting, double hollow rod cylinder in tension at all times, regardless of the direction of table travel. The main cylinder is fastened to the planer table. Fluid flows through the hollow rods and into the cylinder through the holes drilled near the piston. One end of the rod is secured to the planer bed, and the other to the tension cylinder piston. The tension cylinder is fastened to the planer bed and it is always under the same pressure as the main cylinder. Force in the tension cylinder is greater because of its larger piston area. This assures that the rod is in tension even when the table and cylinder are moving toward the tension cylinder.

shuttle valve *B* which opens the proper suction line to tank.

The pump outlet ports are each connected to opposite ends of the table cylinder. Since the volume of oil pumped out of one port is never equal to the volume returned, additional oil must be taken from the tank, or excess oil returned to it. Relief valves *C* set at 1500 psi protect the main lines. As the pump is always working at load resistance pressure, no energy is wasted by discharging over the relief valves during normal operation.

To start the planer, a level-operated rotary valve *D* is shifted, closing the bypass valve *E*. Since pilot pressure to shift valve *E* is furnished by the small pump, the table will not move unless the pump is running. If pilot pressure is lost, valve *E* opens and bypasses pump output, bringing the table to rest.

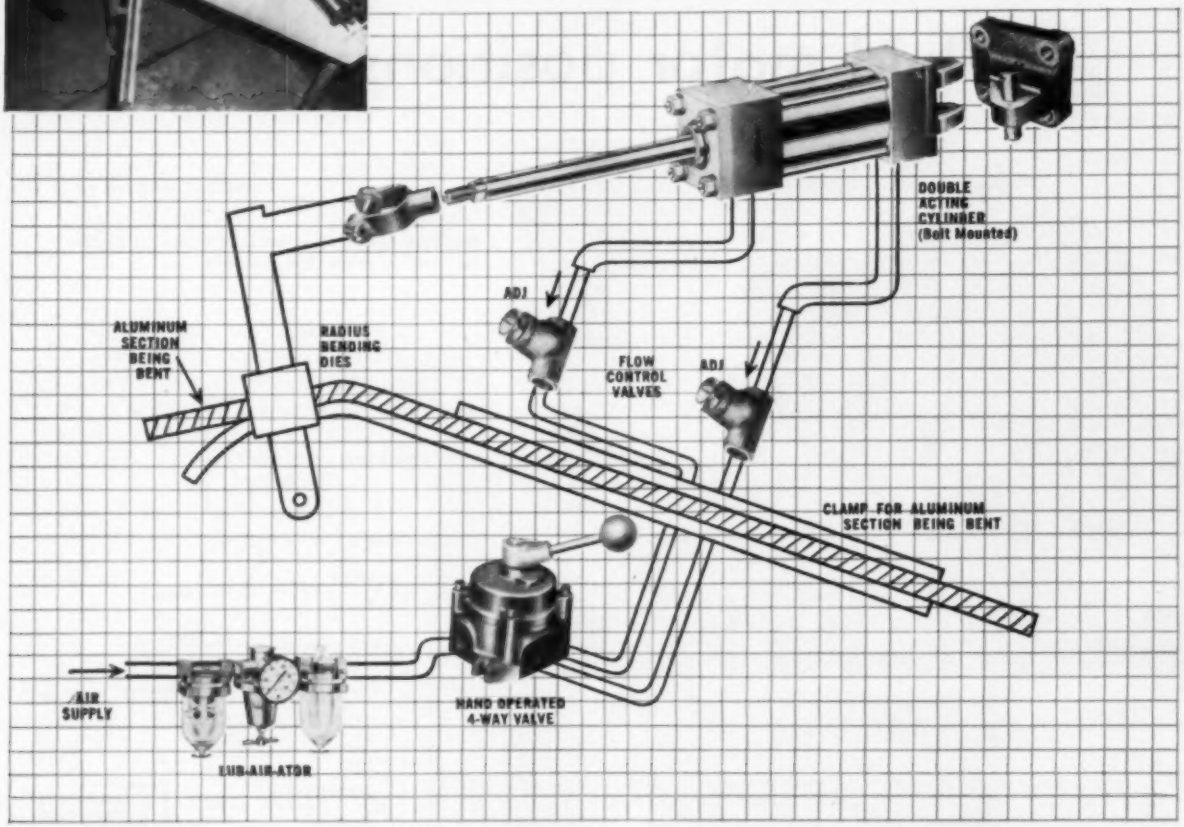
Because the main pump is operated by pilot pressure, it too would stop. To control table acceleration from stop without changing table speed (pump output), an orifice is in the pilot line to valve *E* to control its shifting speed. A check valve bypasses this orifice in the opposite direction, so that the valve will open and stop the table quickly.

• **Differential circuit**—As described, the basic circuit produces table speeds to 88 ft./min. A differential circuit produces a second speed range to 172 ft./min. Two pilot-operated, 2-way valves, one normally open *F*, and the other normally closed *G* are actuated by a lever-operated, rotary pilot valve. When the rotary valve shifts to the *high* speed position, valves *F* and *G* move to *close* and *open* respectively. However since pilot pressure to shift them is from one outlet of the main pump, they shift only when the main pump is stroked to the cutting position and fluid is directed to the head end of the cylinder. Fluid from the rod end is blocked from returning to the pump by valve *F*, and is routed to join fluid going to the head end through valve *G*. At the end of the cutting stroke, when the pump lines reverse for the return stroke, fluid from the head end of the cylinder is directed to tank and loss of pressure causes valves *F* and *G* to return to their normal positions. This cycle continues as long as the rotary valve is in the *high* speed position.

• **Tool feed and clapper box circuits**—The pilot pump operates a rotary torque actuator through valve *H*. The actuator is installed in the planer bed and coupled with a chain and sprocket to the tool cross-feed drive shaft. At the end of the return stroke, the actuator indexes the tool heads for the next stroke. Tool head feed is powered and adjusted through the same linkage used in the original machine before conversion.

Pilot operated valve *I*, in parallel with valve *H*, actuates two small, single-acting air cylinders to lift the clapper box and tools off the work at the end of the cutting stroke. ▼▼▼

A typical example of how fabricators use Schrader. Schrader Air Products in the schematic perform a metal-forming operation at Lance Awning Corporation, Lake Worth, Florida. Power is supplied by a Schrader double-acting bolt-mounted air cylinder. By pressing the Schrader 4-way valve, the cylinder piston advances at proper speed, checked by Schrader flow control valves, bending an aluminum section to the desired angle. Reversal of the 4-way valve returns the cylinder and bending dies to rest, permitting removal of the bend section. "Air control provides a straightforward one-man job," says the Plant Manager. "Two men worked hard to form this radius bend on 25 parts per hour before a Schrader Air Cylinder was installed. Now one man forms 35."



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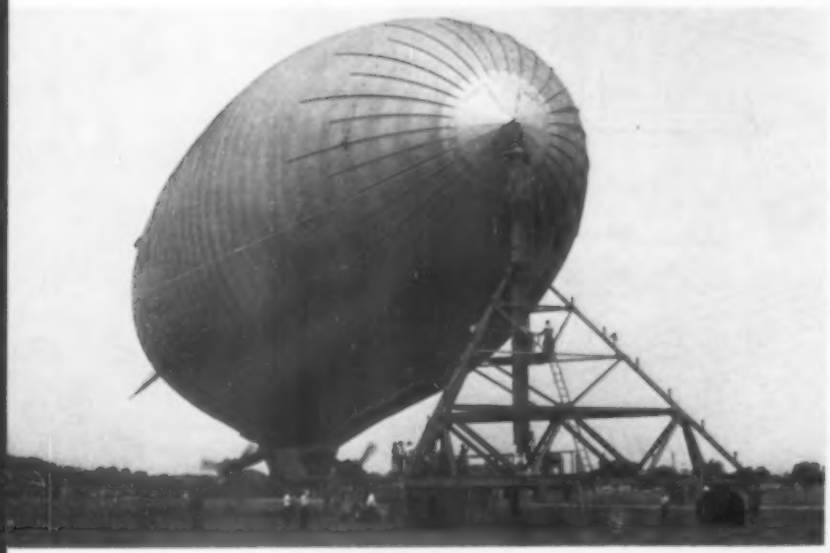
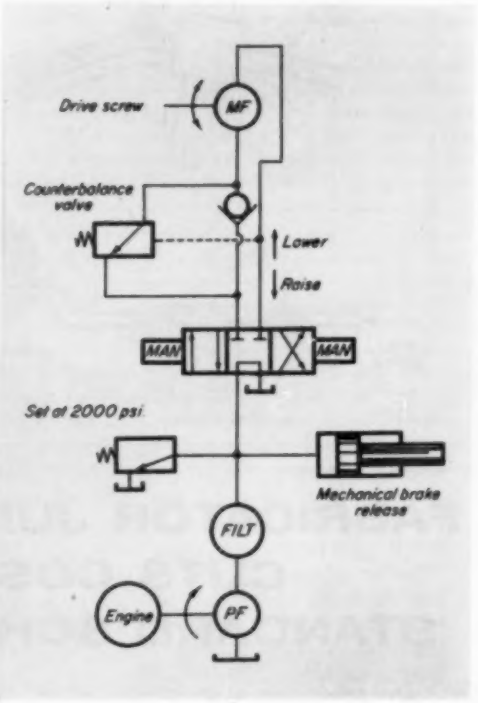
Adjusting mooring mast height to mate with a blimp's nose cone requires delicate control and fast braking. A fluid motor coupled to a drive screw does all fine positioning.

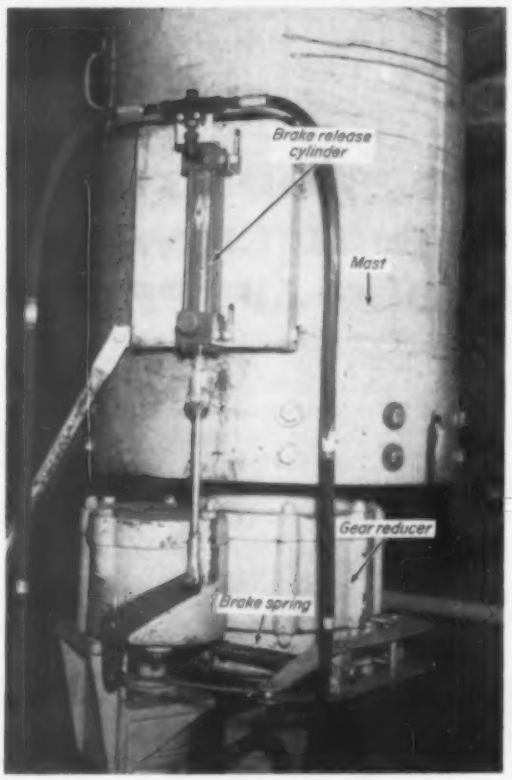
Fluid motor positions a mooring



ON THE MAST! The hydraulic system to position the mast is simple, fast and safe.



BRAKE RELEASE CYLINDER protects against line failure. Pressure loss drains cylinder and allows spring to engage brake. Inexpensive counterbalance valve creates a back pressure to prevent the blimp from overloading the drive screw and driving it down.



BASE OF THE MAST, showing the braking components. Any hydraulic line failure would instantly de-pressurize the cylinder, allowing the spring to engage the brake.

mast

• By **MARTIN GAYNES,**
Project Engineer,
Goodyear Aircraft Corp.,
Akron, Ohio

RATHER than use high cost, high inertia electric motors to elevate this blimp mooring tube, Goodyear engineers found that a hydraulic system can give better service and still have simplicity. Acting through a gear reducer, a fluid motor turns a ball screw drive to raise or lower the mast.

A counterbalance valve prevents uncontrolled lowering. Without some back pressure device, the weight of the blimp would overpower the ball screw and "run away". The counter-balance valve is a simple, low cost component. It is opened by pilot pressure when the motor is rotated to lower the mast, and closed until pressure builds up to drive the motor. The valve's spring setting is adjusted to provide the supporting back pressure.

When the closed-center, 4-way directional control valve is shifted to raise the mast, oil flows to the motor through the check valve which is in parallel with the closed counterbalance valve.

A separate mechanical, spring-powered brake stops the mast when the 4-way valve is in neutral. The brake is released by a hydraulic cylinder connected between the pump and the 4-way valve. As long as the system is pressurized, the cylinder is extended and keeps the brake released. When the pump is shut off, or pressure is lost for any other reason, the single-acting cylinder is drained, and a spring applies the brake. ▼▼▼

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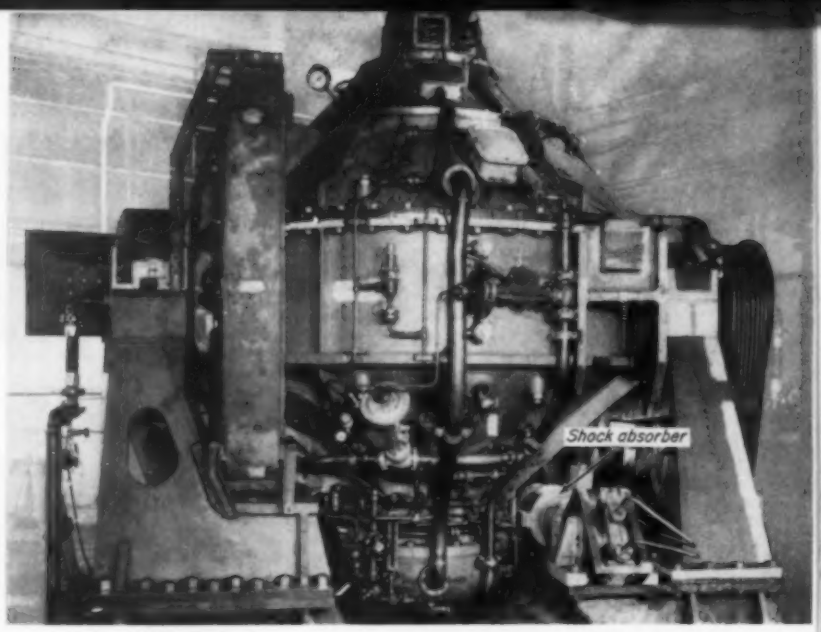


GYROSTABILIZER has a hydraulic system that positions it to resist ship roll. A large shock absorber dissipates the kinetic energy when the 50-ton gyrostabilizer swings too far.

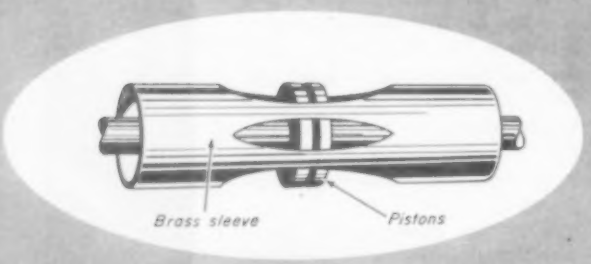
Courtesy Sperry Gyroscope Co. Div. Sperry Rand Corp.

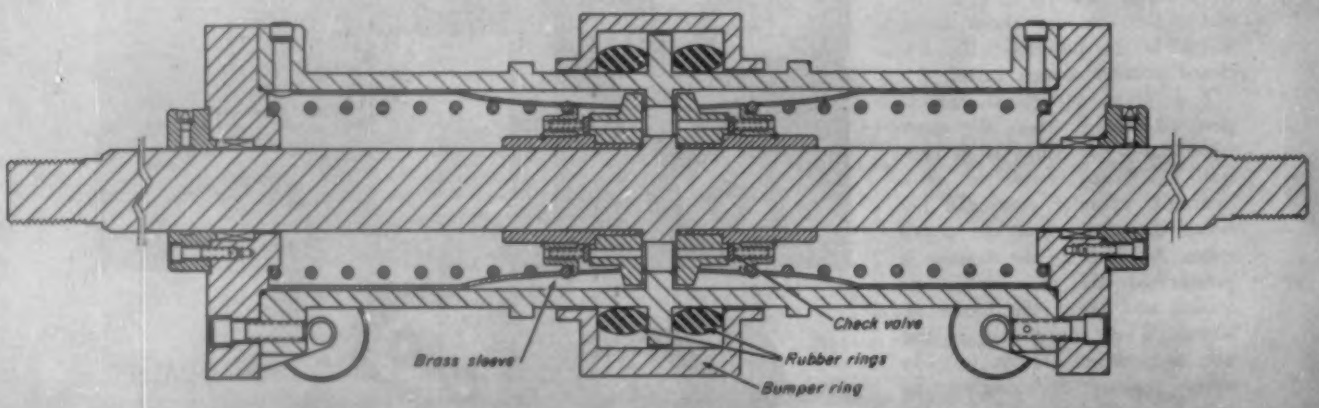
How to snub a gyrostabilizer

• By **JOHN T. ELLIS, JR.**, *Chief Engineer, Hanna Engineering Works, Chicago, Ill.*

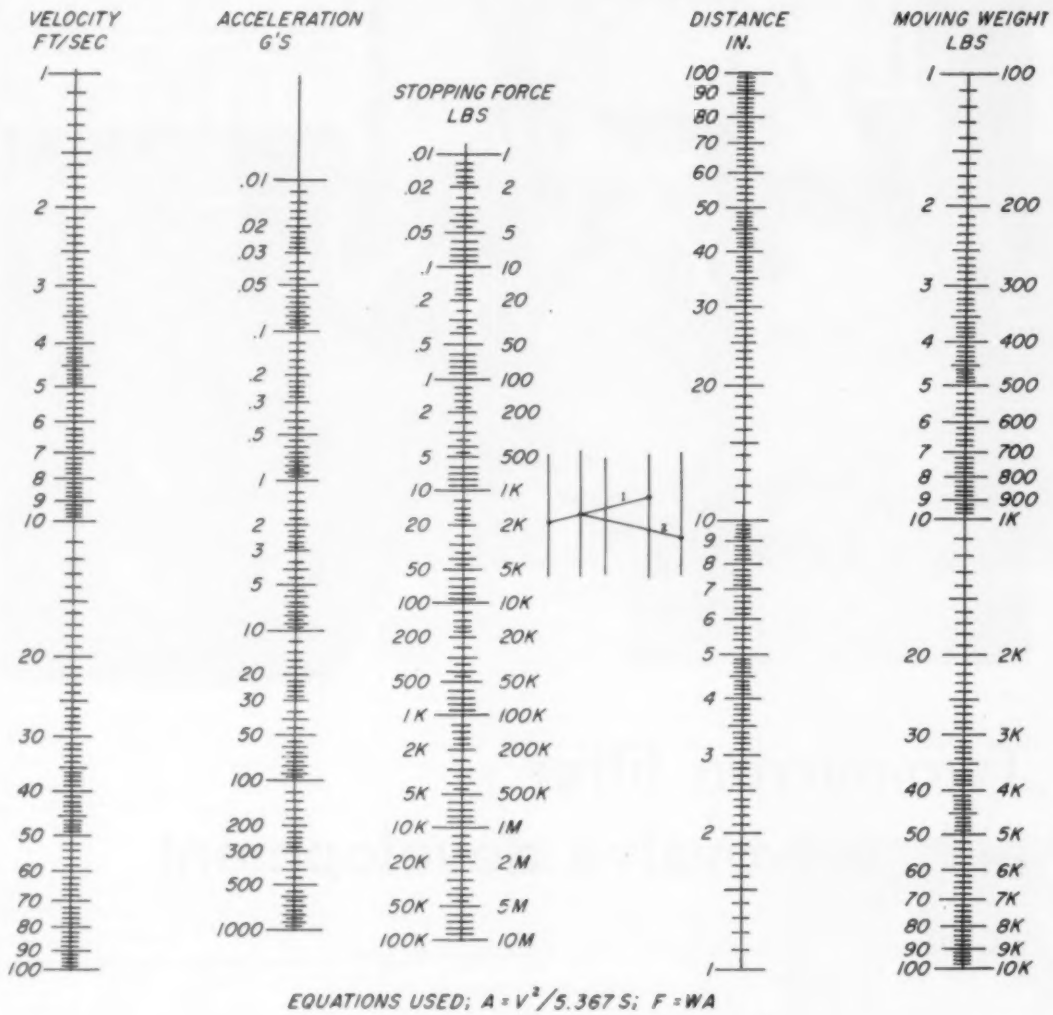
SHOCK ABSORBER'S BUMPER RING is hit when the gyrostabilizer swings to limit. The rubber rings compress and absorb initial force, then transmit it to the flange on the center of the shock absorber cylinder. The cylinder moves one side of the split piston, forcing oil from one side of the piston to the other. Fluid pressure and spring force hold the piston check valves closed. Oil flows through the tapered orifices in the sleeve around the piston.

As the piston moves toward the end of the shock absorber, the metering slots close and the piston decelerates. After the kinetic energy has been dissipated, and the stabilizer rolls away, the shock absorber's centering spring returns it to its center position.





USE THIS NOMOGRAPH TO DESIGN A SHOCK ABSORBER



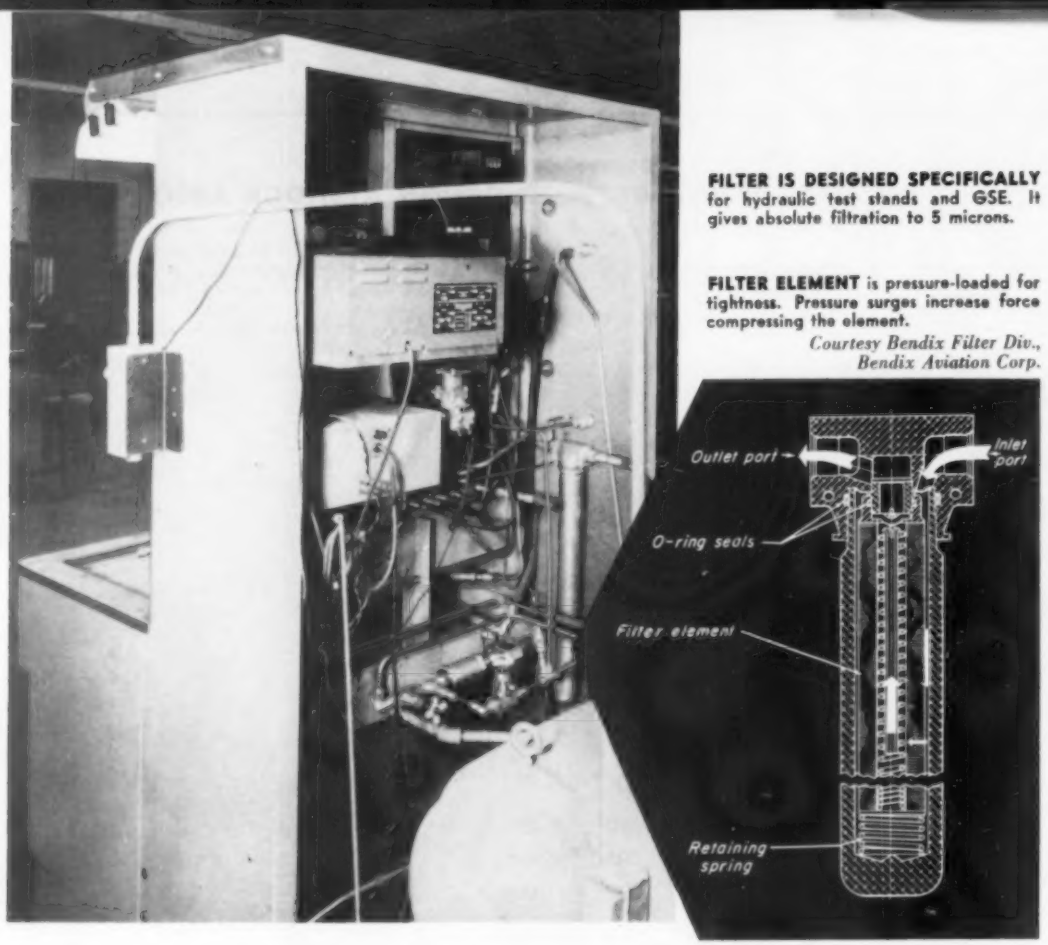
HUGE gyrostabilizers reduce roll in ballistic missile firing submarines. A small sensing gyroscope picks up the first indication of roll and transmits it to a hydraulic system that positions the gyrostabilizer to resist the rolling force.

A built-in shock absorber* dissipates the energy if the gyrostabilizer tilts to its limit. The shock absorber is basically a double rod end cylinder filled with oil. The rod ends are attached to the submarine floor plates and the cylinder body moves with the stabilizer to absorb shock.

As the cylinder moves, oil flows around the piston from one end of the cylinder to the other. It passes through tapered orifices in a sleeve around the piston. As the piston moves away from center, it covers more of the orifice in the sleeve, and gradually decreases oil flow around the piston.

• **Designing a shock absorber**—The nomograph shows the force (F), required for a shock absorber to stop a moving mass at various velocities (V). A line between the velocity and required stopping distance, (S), intersects deceleration rate. Then a line between deceleration rate and moving weight (W) intersects stopping force.

Patent Pending



FILTER IS DESIGNED SPECIFICALLY for hydraulic test stands and GSE. It gives absolute filtration to 5 microns.

FILTER ELEMENT is pressure-loaded for tightness. Pressure surges increase force compressing the element.

Courtesy Bendix Filter Div., Bendix Aviation Corp.

Two-micron filter aids servovalve development

● By **D. A. KING**, *Project Engineer, Cadillac Gage Co., Roseville, Michigan*

TWO-MICRON filtration helps engineers design and test servovalves accurate enough for aircraft. By eliminating small, random contaminants which make measurements erratic, they can study effects of various passage diameters, power input levels, spring pressures, and pilot pressures on shifting speed, pressure drop, and feedback signal.

Engineers at Cadillac Gage Co. needed a high-performance oil filter to control fluid cleanliness in testing missile and aircraft servovalves. It had to pass 10 gpm of MIL-H-5606 or OS-45 fluid, at pressures to 4500 psi, and temperatures to 350 F.

A hydraulic test stand filter was installed in the pressure side of the system, downstream from a 10-micron filter. The 2-micron element can be washed with solvents, steam-cleaned, or backwashed with clean fluid.

The 2-micron element is a cylindrical stack of phenolic resin washers, each .005" thick. A spring inside the cylinder holds the washers together. The lower end of the spring is attached to the end cap, which applies the compression load to the stack. Oil flows from the inlet port in the aluminum alloy head, into the aluminum bowl. Flow through the element is from outside to inside. Since the minimum flow path is more than 3000 times the rated pore size, needle-shaped particles can't penetrate. Small particles can't contaminate by silting (forming a mass).

▼▼▼

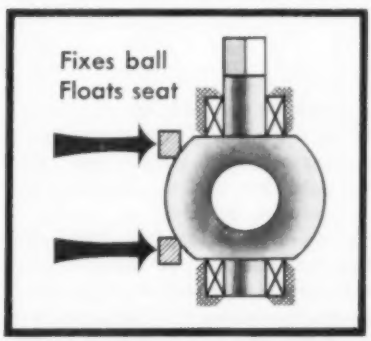
Can A Ball Valve Operate, Cycle After Cycle, With No Maintenance At All?

Read this remarkable answer, and discover an amazing engineering feat.

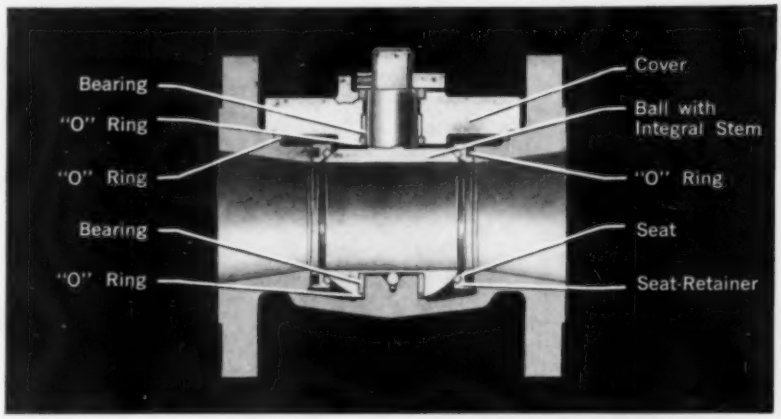
As most engineers know, ball valves offer a number of distinct advantages over all other types of valves . . . 90° on-off, minimum pressure drop, positive on-off indication, no lubrication, and compactness. In common with other valves, however, the design was insufficient to overcome the problem of continual maintenance.

Four years ago, this problem was faced by Hydromatics, Inc. in the valves that they produced for use in missiles, aircraft and ground support systems. Then, as today, all other ball valves were built with a ball that floated in its socket, and sealed by being forced against its seat by the pressure in the line. This caused seat distortion which made early replacement necessary.

Hydromatics tried a different approach. Rather than use the traditional floating ball, their engineers fixed the ball in bearings.



In the bearing-fixed **FLO•BALL** valve all pressure forces exerted on the ball are transmitted to low-friction bearings, thus eliminating down-stream seat distortion due to ball load. The pressure balanced seat, with its teflon sealing surface, is continually self-adjusted by the O-ring in the seat retainer.

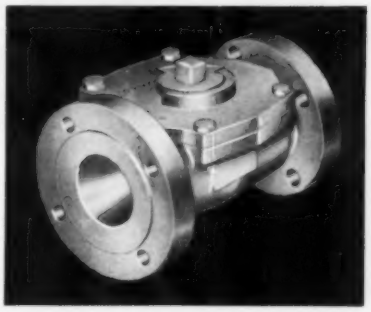


This O-ring acts as a self-energizing force that keeps the teflon seat always in contact with the ball. This insures positive sealing without seat distortion, and minimizes seat-resisting frictional forces. The combination of these low frictional forces results in low operating torque and extremely long seat life.

The bearing-fixed **FLO•BALL** valve proved itself immediately. Hundreds of missile and spacecraft systems, previously impossible, were made possible with these valves. The X-15, America's first manned space vehicle, for instance, has a Hydromatics **FLO•BALL** valve at its heart. Since its inception, the **FLO•BALL** has been used in more varied applications than all other ball valves combined.

Now, after the toughest application testing in history, bearing-fixed **FLO•BALL** valves are being mass produced for industry. They are available for off-the-shelf delivery to standard ASA dimensions in semi-steel, carbon steel, stainless steel, and aluminum. They operate at pressures to 600 psi, temperatures to 400°F and hold vacuum to 10^{-6} mm. of Hg!

The bearing-fixed **FLO•BALL** offers extra ball valve advantages. Top loading for easy access without removing the valve from the line, plus three features that are absolutely unique! Self-adjusting seats which automatically compensate for wear, proportional sealing force which automatically increases with line pressure, and the lowest torque, by far, of any valve. These combine to make the **FLO•BALL** valve virtually maintenance-free!



How long does it last without maintenance? Frankly, we don't know, since the first valves we ever built are still going strong and outlasting other valve types by more than 10-to-1. But don't take our word for it. See for yourself. Call, write or TWX for further information.

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Livingston, New Jersey
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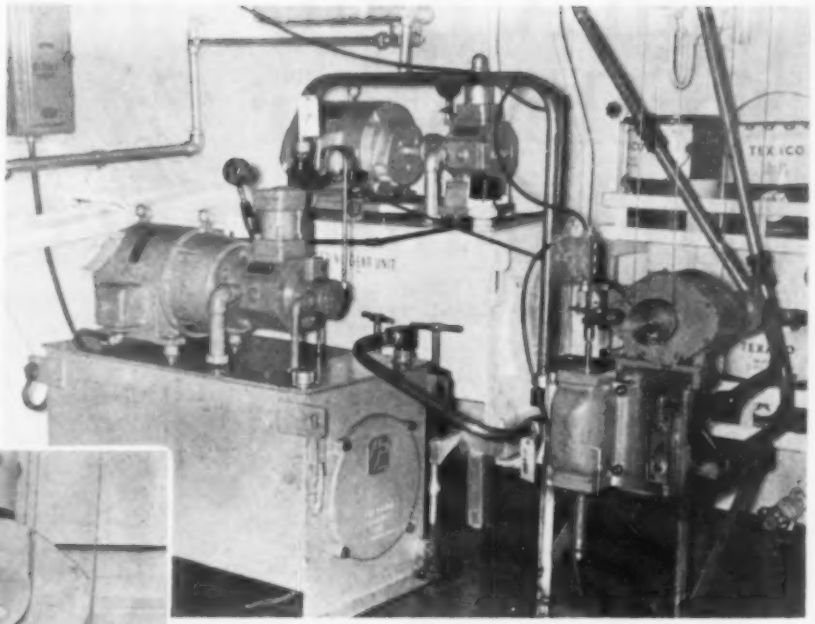
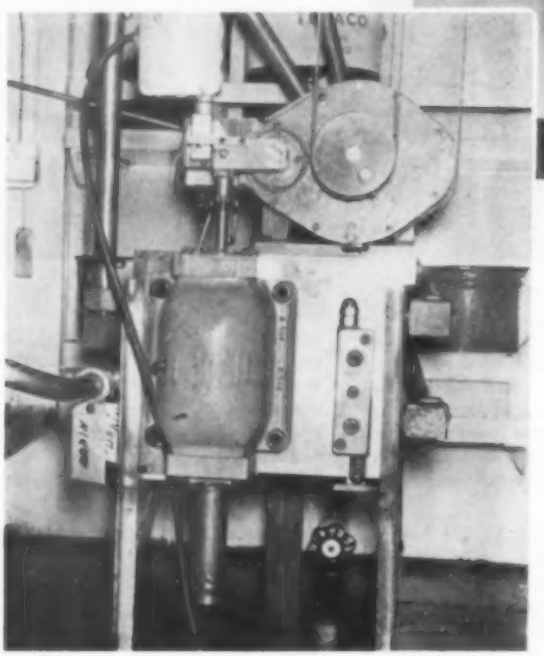




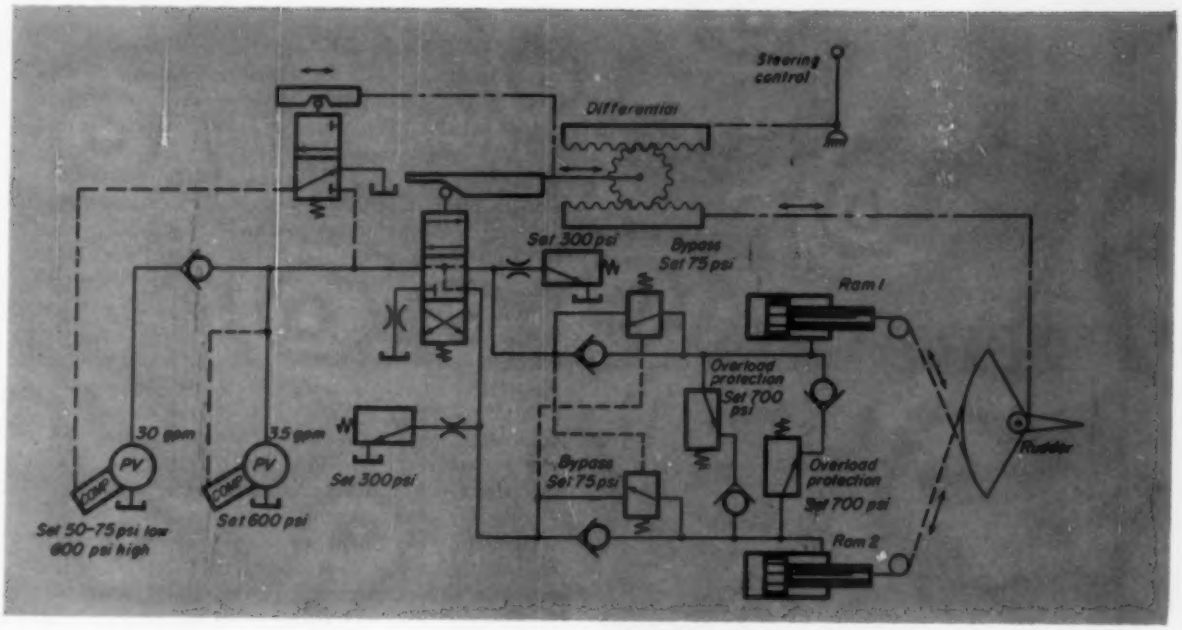
HYDRAULIC POWER PACKAGE which flange-mounts two compensated pumps on an electric motor replaces an older arrangement (background) having a single pump. Four-way valve (inset) is manifold mounted. It has a spool extension which is actuated by a mechanical differential. A spring, shown at the bottom of the valve, loads the spool and differential to eliminate backlash effects.

Servo's memory gives tug

• By **ELMER F. HEISER**, *Precision Products, Inc. Cleveland, Ohio*

A HARBOR tug captain must watch his tow lines constantly. In tricky operations he is at the pilot house door or even outside much of the time. He must make course changes fast, and the rudder must move to the required position quickly.

A steering system recently developed by Precision Products meets these requirements by using a mechanical differential which is the *mixer* of a servo system. Like the system it replaces (also designed by Precision) the new arrangement is controlled by a vertical lever in the pilot house. In the old system, a follow-up linkage connected the rudder, steering valve, and lever. Lever movement shifted the valve which ported fluid to operate the rudder. As the rudder moved, the follow-up closed the valve. The pilot had to hold the lever to keep the rudder turning. He could not move the steering lever faster than the rudder



TWO FEATURES OF THIS CIRCUIT make it efficient. Pressure-compensated pumps deliver to the system only when required. When the 4-way valve is in neutral, the small pump deadheads at 600 psi, the large pump deadheads at 50-75 psi. Bypass valves in the ram lines meter fluid only when required and assure that at least 75 psi is applied to the pulling ram to prevent rudder movement by water forces.

fast steering

moved, so he had to stay at the steering station until the rudder reached the correct position.

The former system was powered by a single, 30-gpm pressure compensated pump. This gave high delivery at low rudder torque and low delivery at high rudder torque to keep power within limits. The pump's delivery was unloaded through an open-center, 4-way valve when no flow was nedeed. But the open-center valve required long spool movement to block its open tank port then direct flow to its cylinder port.

Usually, steering requires small, slow rudder changes to hold a course. Frequent valve changes from unloading 30 gpm, to directing a small cylinder flow at pressure caused shock. Also, the valve's broad deadband reduced accuracy of rudder indication in the pilot house.

Continued on page 96

SINGLE HANDLE steers the tugboat. It actuates a mechanical differential which mixes this input with feedback from the rudder. Handle can be positioned then left unattended while rudder follows to a corresponding position. This allows the pilot to check on his boat's operation.

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SERVO'S MEMORY GIVES FAST STEERING

Continued from page 95

The closed-center valve of the new system has a total deadband of less than .005 in. Its slight overlap in neutral position gives an accurate indication of rudder position. Small steering lever movements cause instant rudder response.

• **Mechanical Servo Control**—In the new system, a mechanical differential mixes steering lever input with rudder position, and actuates the main 4-way valve according to the difference (error). It permits the pilot to set his lever quickly, then watch the tow lines while the rudder moves to the set position. Cams in the differential give proper acceleration and deceleration. The differential's design is represented linearly for simplicity in the circuit diagram. Actually, its action is rotary.

Steering lever movement positions the top rack; rudder movement positions the bottom rack. When the pilot steers to a new position, initial action is to roll the pinion along the bottom rack which initially remains stationary. This positions the 4-way valve to one of its extreme positions, porting flow to one of the rams and exhausting the other. When the rudder reaches a position corresponding to the steering lever, the differential shifts the 4-way valve to its closed center position, shutting off flow. An indicator light then comes on. An electrical interlock prevents starting up the system if the directional valve is not closed.

• **Pump Control**—The closed center, directional valve permits using two pressure compensated pumps for greater efficiency within power limits. A 3.5-gpm pump is spring-loaded to deadhead (zero delivery) at 600 psi. A 30-gpm pump is spring-loaded to deadhead at 50-75 psi when the directional valve is in neutral. When the mechanical differential shifts the directional valve, it also shifts a 3-way valve which ports pressure fluid to the compensator of the large pump. The pump is then compensated to 600 psi.

For open water operation, where only slight rudder corrections are needed, the small pump supplies almost all the fluid while the large pump deadheads at 50-75 psi. If a fast turn is needed, 33.5 gpm is available. Spring compensation lets pump displacement follow rudder torque, giving maximum flow at low torque and reduced flow as torque increases. The rudder of a 1200-hp tug can be rotated from hard-over to hard-over in 5 to 6 seconds with 7.5 hp connected.

• **Counterbalancing with Bypass Valves**—Contrary to usual practice, separate, single-acting rams are mounted along each side of the rear deck. They actuate the rudder through separate chains or cables connected to a quadrant on the rudder shaft. Pressure fluid is applied to the rod ends of the rams.

Tension must be held on the chains because forces on a rudder vary, and reverse completely as the vessel goes from ahead to astern. Otherwise, as the rudder turned, force of the water could pull one ram faster than the pumps could supply the other ram.

Counterbalance valves which provide a constant back-pressure would not be suitable to keep the chain

Concluded on page 98

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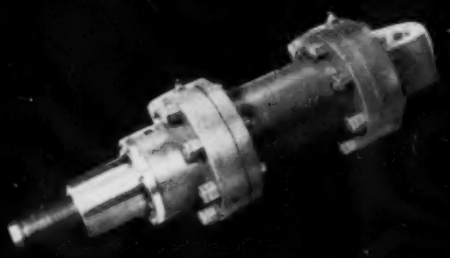

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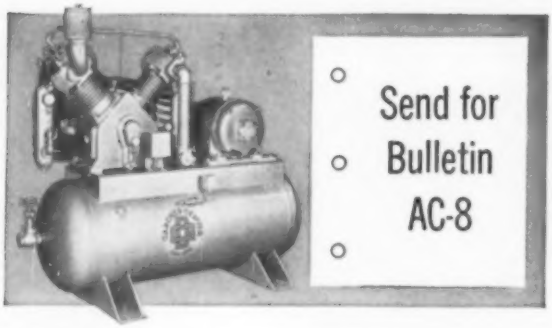

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SERVO'S MEMORY GIVES FAST STEERING

Concluded from page 96

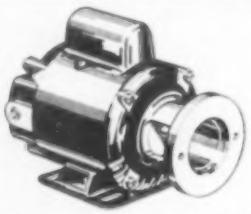
taut because back pressure requirements range from 75 psi to 600 psi.

The counterbalancing arrangement used in this system is very efficient, because it operates only when needed and only to the degree required. Check valves in each ram line direct return fluid from the ram through normally closed bypass valves. These valves are opened by 75-psi pilot pressure and meter flow from their full closed to full open position.

Each valve's pilot line is connected to the opposite ram line, so that at least 75 psi must be applied to the pulling cylinder to open the bypass valve and permit movement. This forms a meter-out circuit assuring a minimum of 75 psi for tension on the pulling ram, regardless of the rudder's speed or external forces.

When the 4-way valve is in neutral, leakage through its closed center position holds counterbalancing pressure on the rams. This is limited to 30 psi by relief valves in the ram lines. Restrictors ahead of the reliefs limit flow when the rams are actuated.

Although this system was developed for marine steering, the combination of a .005-in. overlap, 4-way valve actuated by a differential can be applied to many control jobs where accurate, remote positioning is needed. The differential can be operated by a rotating shaft, rack and pinion, cable, or chain. ▼▼▼



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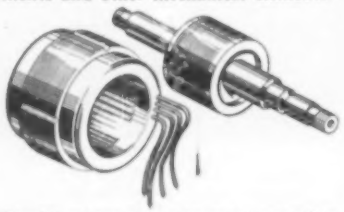

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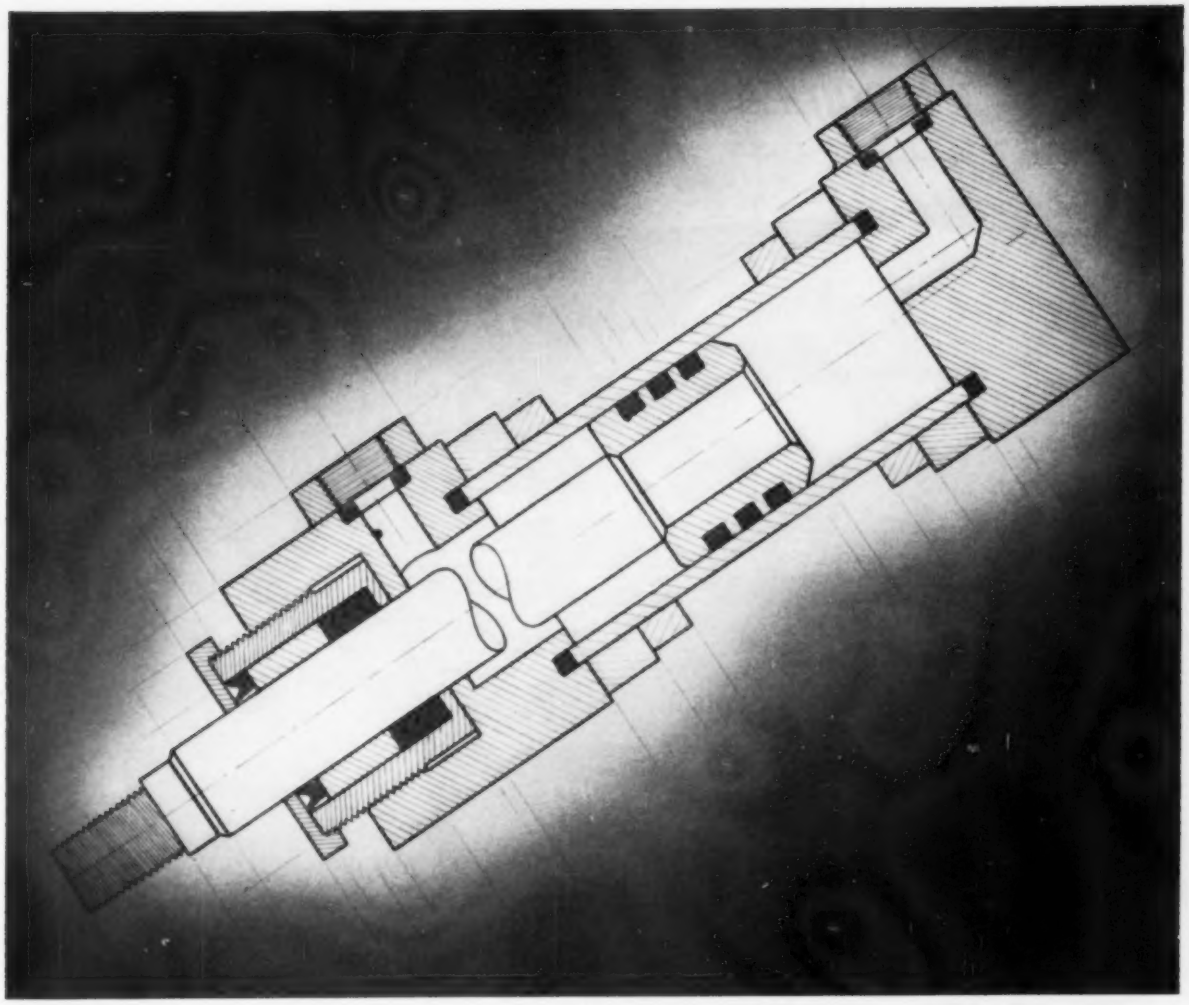

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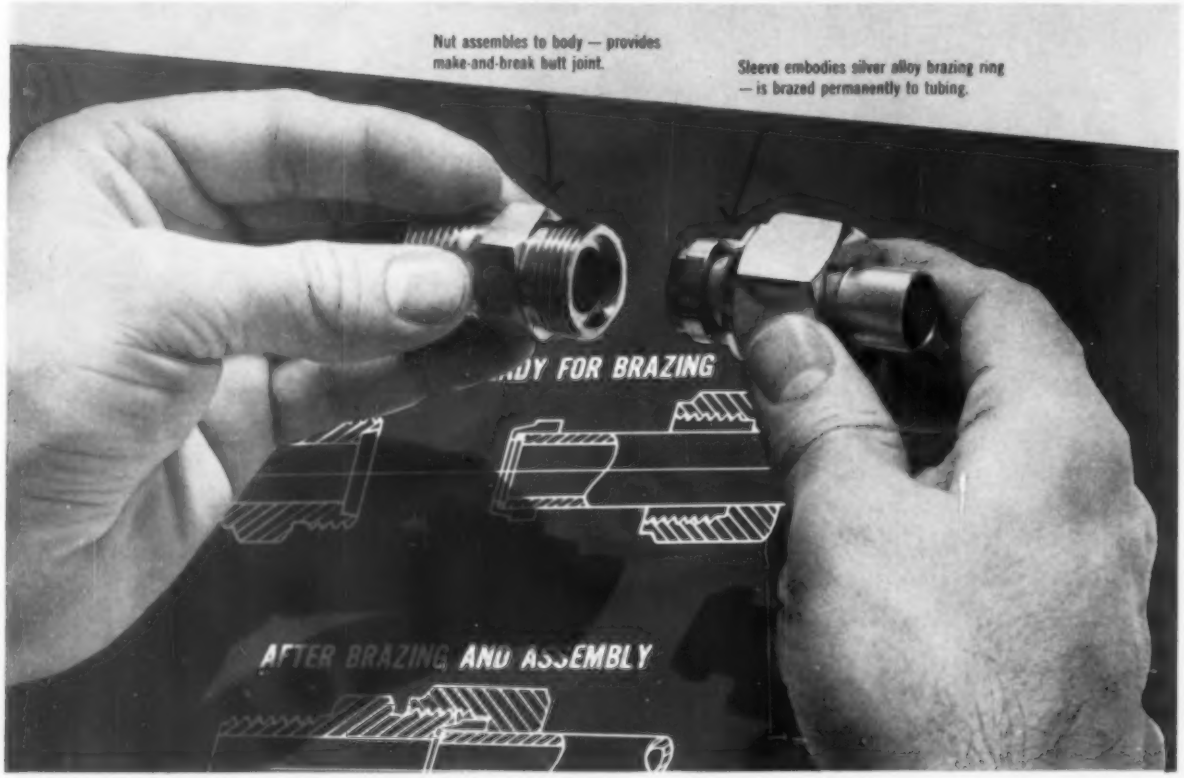

Nut assembles to body — provides make-and-break butt joint.
Sleeve embodies silver alloy brazing ring — is brazed permanently to tubing.
AFTER BRAZING AND ASSEMBLY

NEW BRAZE-SEAL TUBE FITTING

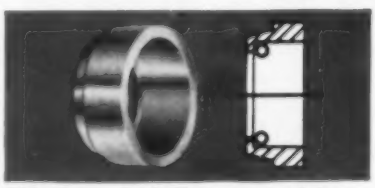
WITHSTANDS SUPER-PRESSURES, HIGH TEMPERATURES . . . RETAINS MAKE-AND-BREAK CONVENIENCE

Until Imperial Braze-Seal came along, engineers could not specify an economical make-and-break fitting for tubing circuits involving super-pressures and high temperatures. Applications like these called for welded connections. But now Braze-Seal offers high reliability, even under extreme pressures. (See chart below.)

MAXIMUM DESIGN PRESSURES (PSI) FOR BRAZE-SEAL FITTINGS

Tube O.D.	316 Stainless	Carbon Steel
3/8"	64,000	48,000
1/2"	62,400	46,800
9/16"	61,600	
5/8"	61,600	46,200
3/4"	60,000	45,000
7/8"	56,000	42,000
1"	52,000	39,000
1-1/4"	48,000	36,000
1-1/2"	44,000	33,000

Application of the following safety factor is recommended: 4 to 1, for sizes up to ½" O.D.; 6 to 1, for sizes ¾" to 1 ½" O.D.



This Braze-Seal Sleeve, containing a silver alloy brazing ring, is the key to the performance of the Braze-Seal Fitting. It assures a joint that will withstand these extreme pressures because it is permanently brazed to tubing. Yet the fitting provides the convenience of a make-and-break butt joint, as illustrated, and is extremely easy to assemble.

Reducing Sleeves Provide Versatility

Can be furnished to reduce any size Braze-Seal tube end to any specified tube size. Extremely convenient on tees, for example, where any size tubing can be connected to the same tee body.

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To move a 1,760,000 pound load through a brick kiln at precisely 1.3 inches per minute, a variable speed motor drives a fixed displacement pump metering a small oil flow to a large cylinder.

Variable speed drive for controlled cylinder creep

• By **FRANK S. PEARNE,** *Vice President, Pearne & Lacy Machine Co., Los Angeles, California.*

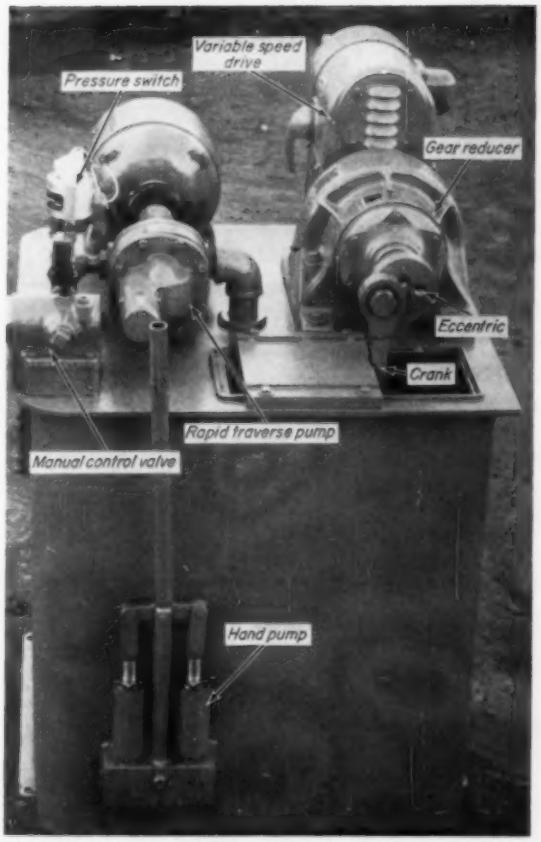
GOOD brick kiln design requires precise baking time as well as high production. To meet this need in one plant, a 410-foot, gas-fired, tunnel kiln was built. Its 44-car, railroad "train", loaded with brick-to-be, weighs 1,760,000 pounds. From green brick to finished product, travel time for a single car through the tunnel is 62 hours and 20 minutes. Time required to travel one car length varies only within 15 seconds. This precise timing assures high quality brick and lower labor costs.

Smooth, slow movement of the brick through the kiln is achieved by a compact, hydraulic kiln pusher.

An 8-inch diameter cylinder, anchored between the car rails at the front of the kiln powers a sliding arm. The arm draws a loaded car into the kiln until it hits the car ahead. This contact raises pressure in the hydraulic system cutting out a rapid traverse pump and starting a variable speed electric drive. The drive rotates a high pressure metering pump that feeds the pusher cylinder at a steady 1.3 inches per minute, continuing movement of the car and the train ahead.

• **Metering Pump Design**—The metering pump, designed by Pearne & Lacy, who engineered the installation, is a dual cylinder pump with lap-fitted plungers and sleeves for long life and low leakage. It can operate at 3000 psi, although it's rated at 500 psi, delivering 120 cu. in./min. It is driven by a gear reducer and crank attached to an eccentric disc on the motor shaft. Flow is controlled both by stroke length and speed of the metering pump. Stroke is adjusted by selecting a hole for mounting the crank on the eccentric disc. Stroke adjustment selects speed range. Precise flow is set by controlling speed with a selector knob on the variable speed drive.

As long as the car is pushed by itself, the rapid traverse pump delivers 16 gpm to move it fast. When



VARIABLE SPEED DRIVE rotates metering pump (mounted inside reservoir) through gear reducer and crank. Pump's displacement depends on hole used for attaching crank to eccentric.

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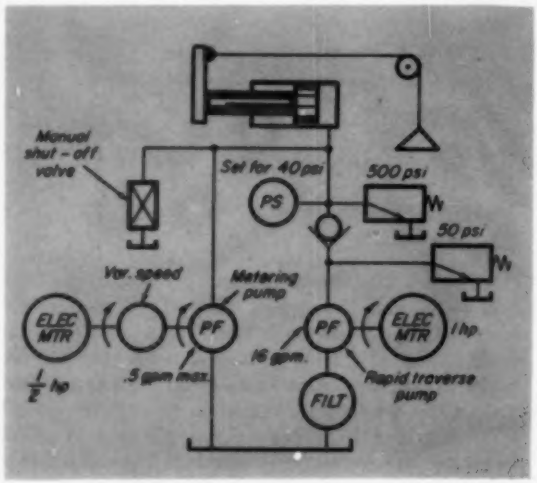
the car contacts the train, a pressure switch starts the metering pump and stops the rapid traverse pump. Pressurized to 285 psi, the pusher cylinder then exerts a force of 14,250 pounds on the 44-car train to move it at 1.3 inches per minute.

To return the cylinder, the manual shut-off valve is opened. This allows the counterweight to pull the cylinder back with exhaust oil flowing through the relief valve.

The single acting cylinder has no packings at its rod end, which is exposed to heat, other than a dust seal (oil seal) to keep out dirt. This design prevents frequent packing replacement.



PRESSURE SWITCH is set just above pressure required to move one car. It stops rapid traverse pump motor, starts metering pump motor.

An exterior-mounted auxiliary hand pump is used to complete a run without interruption, in case of power failure.

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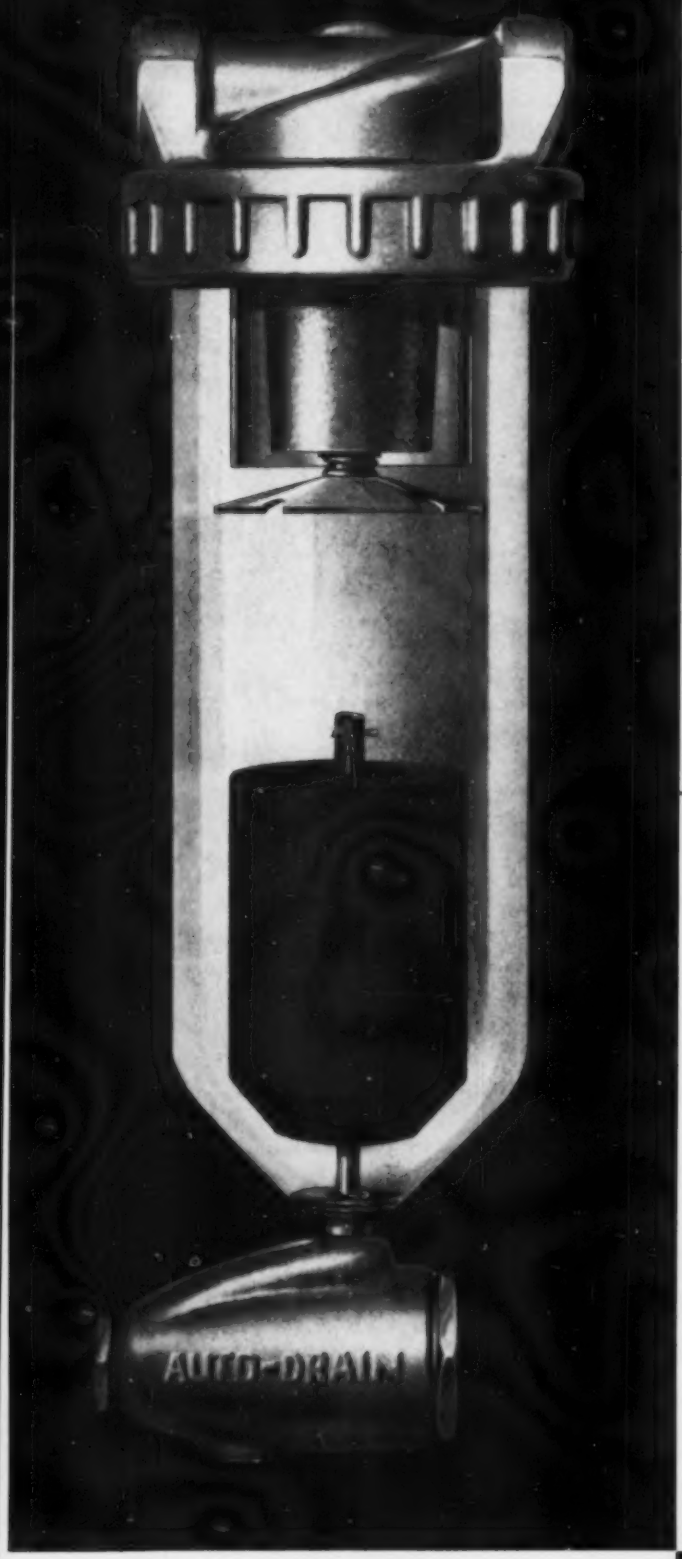

Watts "TORNADO ACTION" filter with new Automatic Drain

Designers — and users — of air-operated tools and equipment specify Watts filters because their superior filtering action and moisture-removing qualities have proved their efficiency. Now, with Watts' new automatic drain, you can have *truly automatic* filtering, too.

Watts "HIGH EFFICIENCY" filters remove condensate from air lines so effectively that draining of the bowl, in some instances, becomes necessary as many as three times daily. To meet the demand for labor-saving components, Watts has designed the "Auto Drain", a completely automatic drain filter which incorporates all the features found in the standard Series 602, 603 filters.

By use of the pilot principle, efficient and dependable removal of foreign particles and liquid condensate is attained. When liquid rises, the float admits air to the pilot valve chamber, opening a scavenger valve and allowing the trapped liquid and impurities to be blown out the drain opening.

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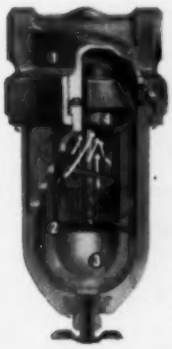

How Watts "Tornado Action" removes condensate and dirt from air lines

Curved inlet ❶ directs incoming air in downward helical pattern. Larger impurities and condensate are "thrown out" by centrifugal action, collecting on bowl sides and spiraling downward past baffle ❷ into quiet chamber for draining-off. Baffle traps sediment in quiet chamber ❸ and allows only dry air centrifugally cleaned of larger impurities to reach filter element ❹ where finer particles are filtered out.

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Use Reynolds Number to compute line size

• By **CHARLES L. ORTON**, *Design Engineer, Pollak & Skan, Inc., Chicago, Illinois*

IN DESIGNING mobile equipment, space is always a limitation. One way to save space is to use small diameter hose for tighter bends.

Selecting a line size depends on laminar and turbulent flow characteristics. The physics of laminar flow have been understood for some time. The physics of turbulent flow are now also understood. Between these two conditions is a range which is still not entirely predictable. But experiments in this range indicate that approximations can be made close enough for fluid power design.

Whether flow is laminar or turbulent depends on the Reynolds Number, N, applying to the particular condition. Laminar flow can be expected at Reynolds Number values below 2000, and turbulent flow at values above 4000. The same formula for pressure drop can be applied to both, as long as we observe these limits.

Loss of pressure in terms of hydrostatic head may be measured by

$$h_f = F\frac{LV^2}{2Dg} \qquad (1)$$

where L and D are pipe length and diameter (in consistent units) and V is the fluid velocity in ft. The term F represents a coefficient of friction which is a function of the Reynolds Number. Below 2000, F is simply $\frac{64}{N}$.

Above 4000 it is more complex, but the formula

$$F = 0.0055\left[1 + \left(20{,}000\frac{\epsilon}{D} + \frac{10^6}{N}\right)^{1/3}\right]$$

is a close approximation. For tubing or hose which both have a high degree of internal smoothness, the factor $\frac{\epsilon}{D}$, even when multiplied by 20,000, is so small that it can be omitted. This gives a much simpler form:

$$F = 0.0055\left[1 + \left(\frac{10^6}{N}\right)^{1/3}\right] \qquad (2)$$

• **Curves eliminate calculations**—You don't have to contend with this formula every time you have a problem in turbulent flow. You can easily make up a table and curve for values of F in increments of 500, for Reynolds Numbers from 4000 to 10,000. And the curve is a very smooth one for easy interpolation.

A similar curve can be made for values of N from 500 to 2000. This takes care of everything except values of N from 2000 to 4000. No experimenters have indicated that F, for any value of N in this range, has a value *below* that for 2000 nor *above* that for 4000. Curves which have been developed for this range are nearly straight. The total variation is only 25%.

If you accept values which are off as much as 5%, you now have a table for coefficient of friction, so that you can calculate pressure drop instead of relying upon arbitrary rules.

To make formula (1) read in terms of psi, multiply by the weight of 1-ft. head of particular fluid, or by $\frac{\rho}{144}$ where ρ is the fluid density in lb/cu ft.

We can express the formula now as:

$$\Delta P = \frac{\rho}{144}F\frac{LV^2}{2Dg} = 0.001078\rho F\frac{LV^2}{D} \qquad (3)$$

$$\text{For } N < 2000,\ F = \frac{64}{N}$$

$$\text{For } N > 4000,\ F = 0.0055\left[1 + \left(\frac{10^6}{N}\right)^{1/3}\right]$$

$$\text{For } 2000 < N < 4000,\ F = \text{interpolation from .0320 to .0400.}$$

The curve for coefficient of friction plotted against the Reynolds Number shows some surprising characteristics. Instead of being low at low velocities, it drops quickly from infinity to unity at $N = 64$. At $N = 1000$ it is .0640 and goes down to .0320 at $N = 2000$. At $N = 4000$, it is up only 25% to .0400, which is the same value it had at $N = 1600$. From 4000 up, it decreases very gradually until at $N = 8900$ it again has a value of .0320. For all higher values of N, the friction factor is lower than the lowest found among laminar flow conditions. Obviously, it is not turbulence in itself, which we need fear.

It is a little trouble figuring the Reynolds Number for a variety of possible line sizes, but not as tough as you might think. The complicated mathematics need to be done only once for each system. For example, on one job, using 140 SSU oil of .855 specific gravity, the figuring of N resolved itself to the simple form of $N = 260\ VD$.

One word of caution: At higher velocities you have to worry more about surge pressures. Until we have more exact formulas it is well to figure 60-psi surge pressure for each ft./sec of velocity, if flow can be stopped instantly. But even this limitation can be overcome. In some systems it may be best to cut surge pressures for the advantage of reducing line size. ▼▼▼

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capability for
actuating a specified
load in response
to an electrical signal

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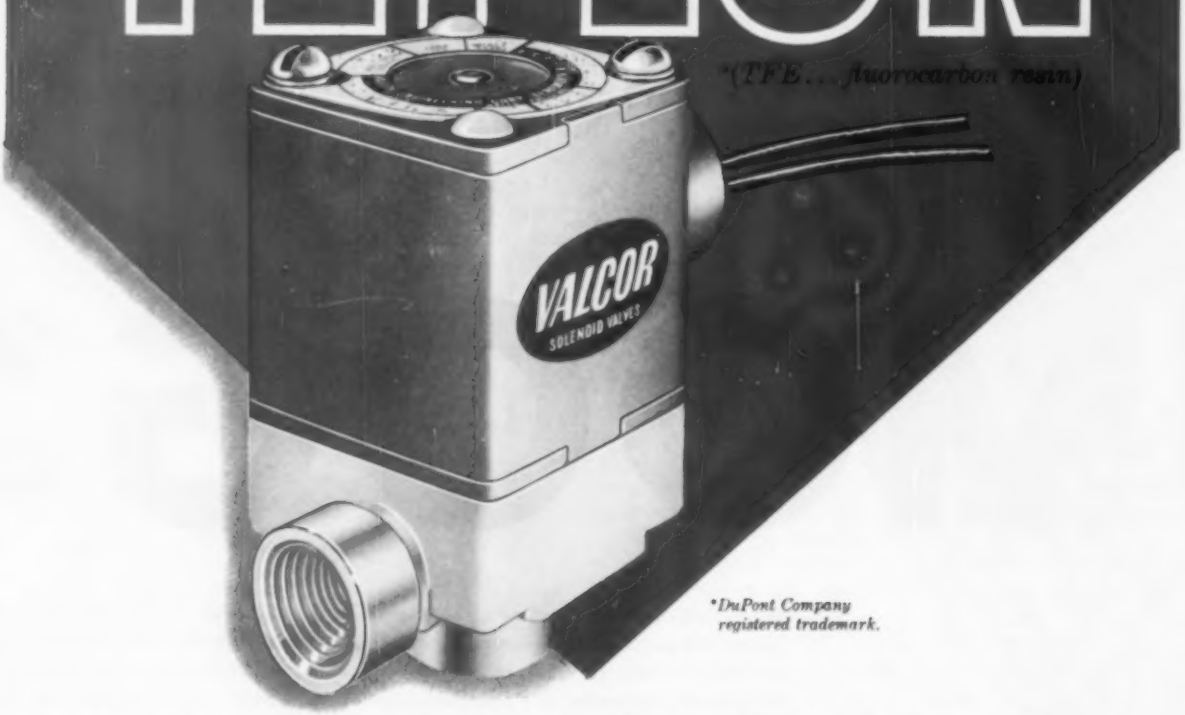

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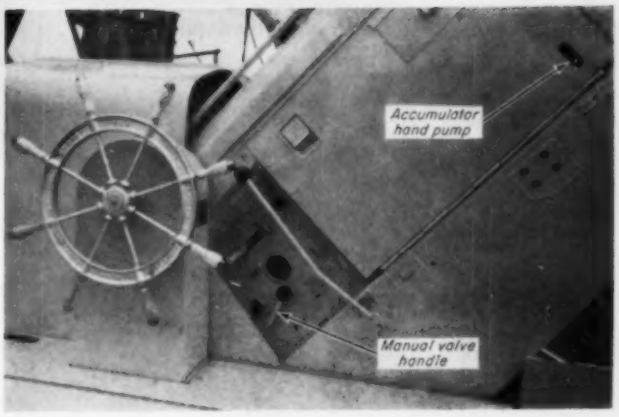


OUTBOARD DIESEL PROPULSION UNIT is designed for shallow water craft like barges, pontoon equipment, and beaching vessels. It's pivoted on its forward end and tilted by two cylinders.

This propeller raises when it hits an obstruction

• By **A. W. WANZER**, *Chief Engineer, Murray & Tregurtha, Quincy, Mass.*

DESIGNED for barges, Navy pontoon equipment, and beaching type ships where submerged obstacles are common, this outboard motor is protected by an automatic retraction system. Two cylinders tilt the engine and raise the propeller out of the water. If the propeller hits an obstruction, cylinder rod end pressure jumps and triggers accumulators which supply the raising system. The propeller is ordinarily raised by an engine-driven pump or a hand pump which extends the cylinders.

The propeller steers the vessel by rotating 360 degrees on its vertical shaft. This rotation is controlled by a wheel at the side of the engine. The wheel actuates a hydraulic servo, torque generator which increases turning torque and rotates the propeller through gearing and shafts. If the hydraulic system fails, steering is directly through the wheel, gearing, and shafts with no boost action from the torque generator.

The two accumulators which supply fluid for emergency raising also supply a fluid motor for starting the diesel engine (see circuit). They are charged to 3000 psi by the engine-driven pumps. With the 4-way valve shifted, the 12-gpm pump first delivers to the cylinders to raise the engine. It then charges the

accumulators to 2000 psi. The small, engine-driven pump continues to charge them to 3000 psi. A hand pump can charge the accumulators when the engine is shut down.

• **Automatic Raising**—The engine and outboard drive are pivoted near the forward end of the engine at the deck line. This brings the entire propeller out of the water for inspection and repairs, as well as to clear an obstruction.

As the propeller moves into an obstruction, at a maximum forward speed of 6 mph, pressure rises in the rod ends of the raising cylinders. With the 4-way valve, controlling the cylinders, in neutral, this increased pressure is applied through a 2-way valve, integral with the 4-way valve, to a sequence valve. When pressure rises to the setting of the sequence valve, the valve opens and applies pressure to a pilot-operated check valve. The check valve opens to allow flow at 3000 psi from the 2¼-gal. accumulators to the head ends of the cylinders. Discharge from the cylinders is through a relief valve set at 325 psi.

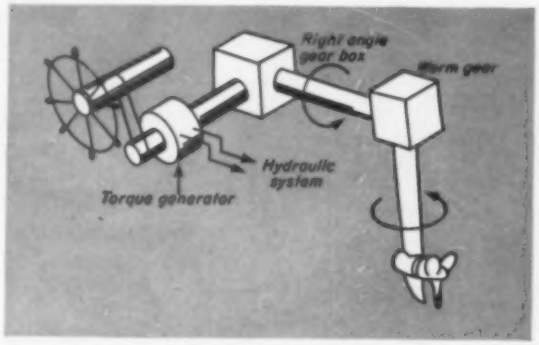
When the obstruction is cleared, the operator shifts the 4-way valve to lower the engine and propeller. The 2-way valve, which is integral with the 4-way valve and shifts with it, then closes off the line to the sequence valve.

An unloading valve dumps this pump's delivery to tank when the accumulators are fully charged.

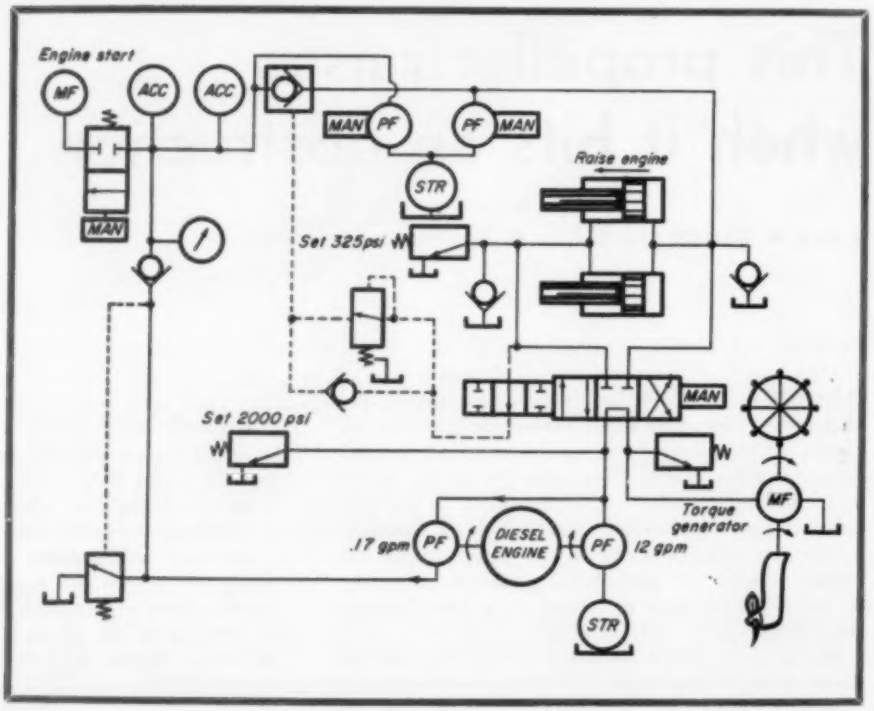
• **Torque Generator for Steering**—Steering is done entirely by rotating the propeller. One revolution of the steering wheel gives one revolution of the propeller vertical shaft. Rotating the propeller shaft 180 degrees gives reverse thrust, so the propeller always works on its proper side for best efficiency. Steering does not rely on inefficient reverse gears or rounded back faces of the propeller. The system always gives full power in the required direction. It is very effective in freeing a beached vessel.

The steering wheel actuates the torque generator through chains. Torque from the generator drives a longitudinal steering shaft through a right angle, steering gear box (see drawing). This shaft connects through universal joints to the steering worm which turns the vertical propeller stem.

As the steering wheel is turned, the output shaft of the torque generator follows at increased torque due to hydraulic pressure appled to it. When the wheel is stopped, the torque generator stops at the same relative position. ▼▼▼



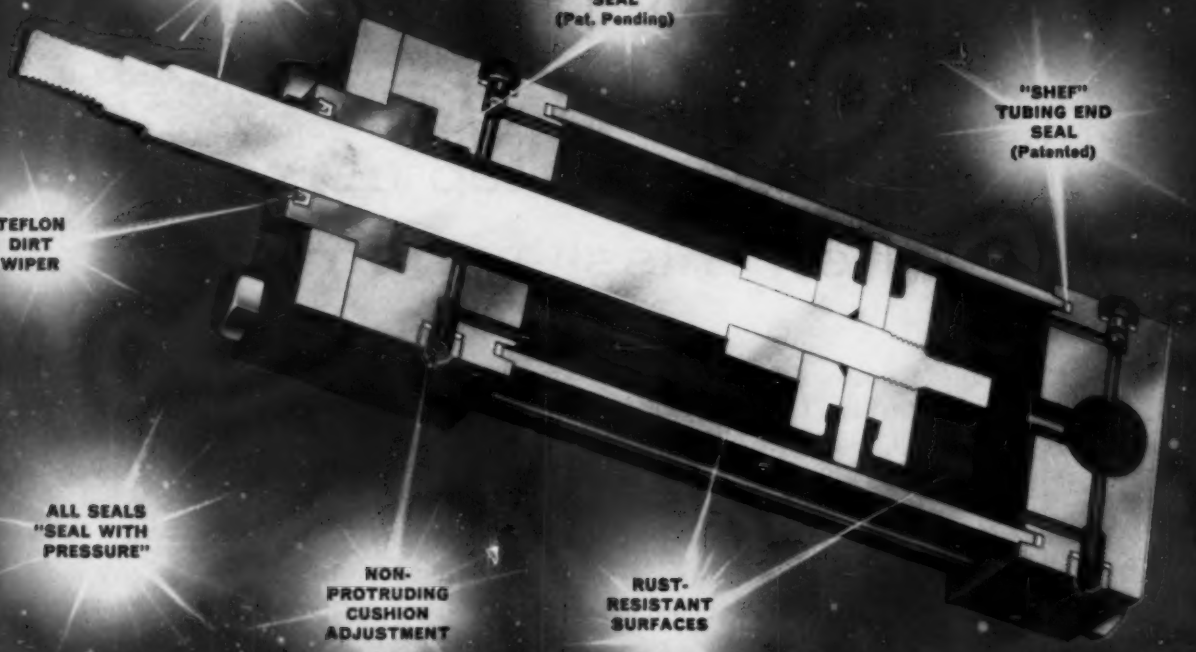
HYDRAULIC SERVO, TORQUE GENERATOR IS CHAIN DRIVEN by the steering wheel. Its increased torque output rotates the propellor vertical shaft through 360 degrees. The steering wheel has one king spoke so the helmsman knows propeller position even in darkness.



FOUR-WAY VALVE, CONTROLLING RAISING CYLINDER has been modified to include a 2-way section. This cuts off flow to the sequence valve and pilot-operated relief valve (which control automatic raising) during normal raising and lowering.

Circle 109 →

Stellar RELIABILITY and ECONOMY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"STA-DYN" ROD FLANGE SEAL (Pat. Pending)
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ALL SEALS "SEAL WITH PRESSURE"
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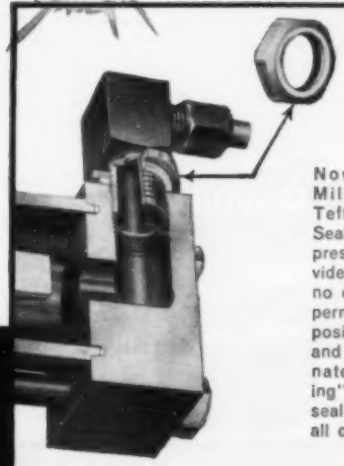
RUST-RESISTANT SURFACES

Miller AIR CYLINDERS

PORT SEALS



Now—with every Miller Cylinder—Teflon-sealed Port Seals that "Seal with pressure" are provided as standard at no extra cost. They permit much faster positioning of lines and fittings, eliminate "overtightening" damage, and seal perfectly against all operating media.

Here are eight more reasons why Miller Air Cylinders continue to be the most economical and reliable cylinders that money can buy. These stellar features—including the new port seals—are standard Miller construction—yours at no extra cost. Thus, they provide appreciable savings in original investment—*particularly for those who insist on "J. I. C." quality throughout.* Savings in operating costs are even greater, because these features are proven assurance of longer cylinder life, greater efficiency, reduced maintenance and downtime.

Specify "Miller" for greater reliability and economy! Write for bulletin.

MILLER FLUID POWER

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CELANESE CELLULUBES used as air compressor lubricants step up safety in new missile submarines...

The advantages of Celanese Cellulubes were clearly apparent after a test program by Electric Boat Division. The tests included a study of lubricants dispersed in air under high pressure, followed by abrupt decompression. This results in a high-speed shock wave which can cause a violent explosion. Hydrocarbon lubricants proved highly vulnerable, but Cellulubes were so effective in resisting these extreme conditions that they will be used in all compressors in the new Polaris Fleet Ballistic Missile Submarines.

Cellulubes are not only outstanding for the prevention of fire and explosion, they give overall wear protection comparable to that of premium petroleum oils. The resistance of Cellulubes to carbon formation eliminates frequent scraping and cleaning of charred residues from valves and other internal parts of reciprocating compressors. Celanese Cellulubes can reduce maintenance requirements for compressors and often for downstream equipment as well. Celanese Chemical Company, a Division of Celanese Corporation of America, New York 16.

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NEW 20-PAGE MANUAL...
shows you the causes of fire and explosion in compressed air systems, based on latest research. This booklet is intended to help plant engineers and management reexamine specifications in the light of the benefits that Cellulube fire-resistant lubricants offer. Send for your copy today.

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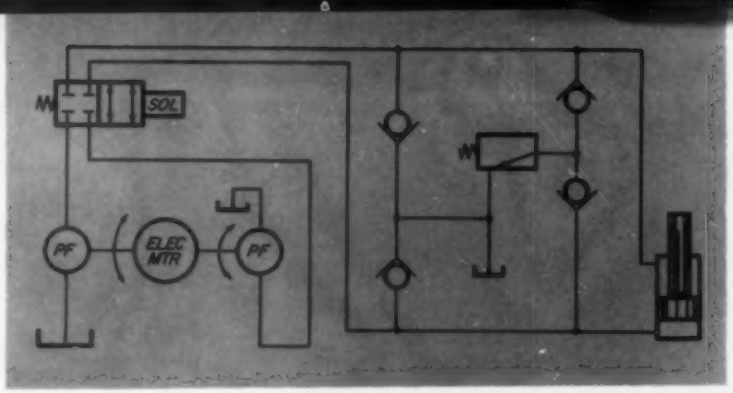
CELANESE CELLULUBES

Metering pumps control double-acting cylinder



• By J. R. FAWCETT, *Timperley, England*

CONNECTING pumps to each end of a double-acting hydraulic cylinder controls speed in either direction. One pump supplies oil to the cylinder while the other meters discharge.

This type of positive control is ideal for operating a crane boom. Reverse loading caused by wind does not affect the boom. Also, the load can't take over and move at a higher speed than that set by the meter-out pump.

In this circuit one electric motor drives the two pumps. The capacities of the pumps are proportional to the effective piston areas of the head end and rod end of the cylinder.

The operator controls the boom by starting, stopping, and reversing the motor. A 4-way solenoid valve wired through a timer, shuts off the cylinder lines a few seconds after the motor stops. When the valve closes it locks the cylinder in place.

A relief valve and four check valves safeguard the system against excess pressure from overloading, or from pressure build-up when the piston reaches the end of its stroke. The check valves also prevent the metering pump from running dry and sucking air into the system. ▼▼▼

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Get these Exclusive Advantages of LEIMAN HINGED VANE DESIGN!

The time-tested design and quality construction of Leiman Air Pumps improve your machine operation—provide your customers with "Lifetime" durability and freedom from troubles and repairs. Proved by more than half a million installations. If your equipment now uses air pumps—if your new designs require air pumps, contact us for engineering assistance and data on Leiman Air Pumps.

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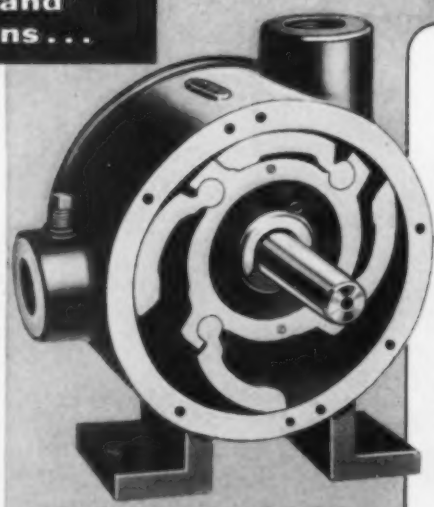

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VACUUM to 29.9" Hg.
PRESSURE to 20 Psig.
VOLUME to 162 c.f.m.

• **Four Curved Vanes** scoop up large volumes of air. Easy-action hinges enable vanes to open and close by centrifugal force.

• **Cast Iron Vanes and Cylinders** are precision-machined, then hone themselves to hard, glossy smoothness during operation—take up their own negligible wear—assure leakproof seal and fully-rated capacity for years and years.

• **Extra-large Air Space** provides 2 to 3 times more capacity per pump, permits use of smaller pump.

• **Minimum Maintenance** because simplified design has fewer moving parts—no gaskets or packing—no composition vanes to replace.

• **Also** quiet operation—even air flow—every pump subjected to long test runs before shipment.

LEIMAN Rotary Positive AIR PUMPS

Write for new catalog showing construction, types, sizes and specifications, plus Application Book containing many "how-to-do-it" blueprints.

SEE OUR CATALOG IN SWEET'S FILE

No coil burnout with SPEED KING®

...pilot operated control valves

• Built to JIC standards • interchangeable pilots • choice of mounting types, optional features • ac or dc, any voltage • ¼ to 1 in. NPT

SPEED KING solenoid pilot coils, potted in molded resin, are unconditionally guaranteed against coil burnout for the life of the valve! And, Speed King pilots are totally enclosed, and sealed against entrance of dirt or moisture . . . valves are fully air-operated for speed and dependability . . . feature a hard-chrome plated stainless steel plunger floating in O-rings, to eliminate wear-producing metal-to-metal contact.

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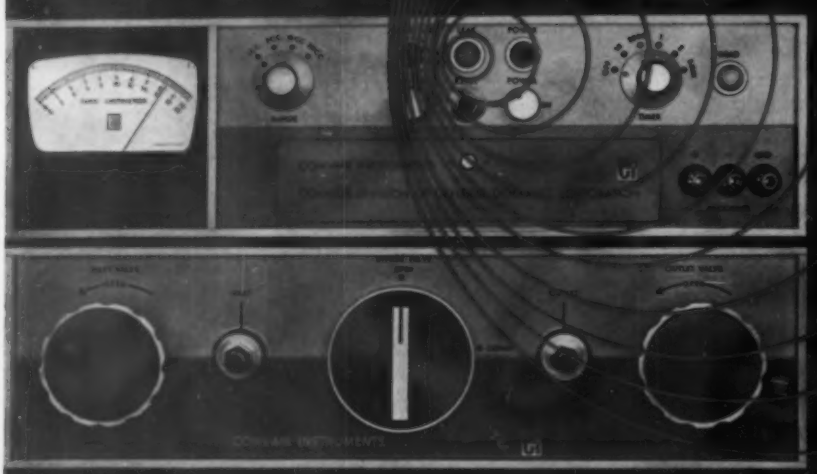
8111

some leaks don't make drops



the all-new CI LEAKMETER doesn't depend upon catching drops in the measurement of hydraulic or fuel leakage!

The CI LEAKMETER, *when installed in a line between a pressure source and the system or component under test, automatically detects and signals the existence of a leak. It automatically measures and indicates the amount of the leakage. A red light signals the presence of a leak –the amount of leakage is indicated on an electrical meter. The* LEAKMETER *incorporates a timer which can be set for test durations of 15 seconds to 5 minutes, providing a range for the instrument of 0.008cc to 80cc per minute. To measure other rates of leakage, or to test for sustained zero leakage, the timer may be overridden and the test conducted for any desired period.*

The LEAKMETER consists of an Hydraulic Assembly and an Electrical Assembly. These may be installed together, or at separate locations in the test area. Both are designed for rack mounting. Hydraulic connections are made by quick-disconnect fittings.

The LEAKMETER is compatible with all common hydraulic fluids and fuels. The item under test may be subjected to shock, vibration, or temperature, from which the LEAKMETER remains isolated. The instrument accommodates pressures to 5000 psi. Jacks are provided for recording or other readout.

For Complete Information–or to purchase a LEAKMETER *for Immediate Delivery, Write, Wire, or Phone:*

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March 1960

AIRCRAFT SECTION

MISSILES • SPACE VEHICLES • GROUND SUPPORT

HIGH TEMPERATURE FLUIDS FOR THE B-58 116

By George H. Craig

A silicone fluid, 85% silicate ester and 15% diester was selected for the B-58. It is a variation of WADC's MIL-O-8200 which couldn't be used because there were no compatible seals for —65 F.

AVIATION NEWS FROM THE FLUID POWER FIELD 120

AIRCRAFT COMPONENT DATA 122

New design approach to hot fluid test equipment demonstrates some hydraulic and pneumatic systems for aircraft and missiles. For more information fill in and mail post card bound in this issue.

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High temperature fluids for the B-58

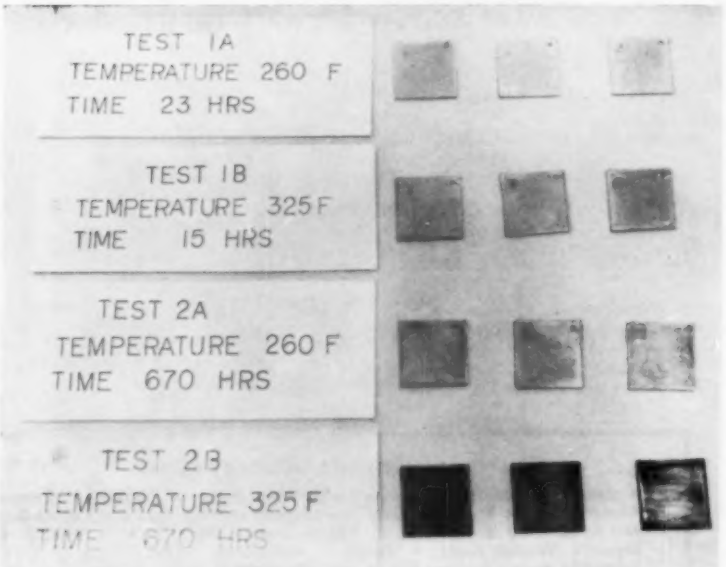
• By GEORGE H. CRAIG
Project Planner, Convair Fort Worth
A Division of General Dynamics Corp.

Here are some unusual properties of a new high temperature fluid used on the B-58 Hustler. To design 350 F systems, the conditions discussed in this article must be kept in mind.

HIGH MACH means hot hydraulics. The B-58 Hustler created the need for a high temperature system.

ANY fluid developed for hot operation must cope with the problems of oxidation, impurity, hydrolysis, flammability, and materials compatibility—among others. To meet B-58 requirements, a research program was started. The goal: solve the problems of a system demanding flows to 120 gpm at pressures to 3000 psi with a maximum operating temperature of 350 F.

Specific heat, compressibility, vapor pressure, and viscosity of fluids are prime factors contributing to system efficiency. The standard MIL-0-5606 does not meet the requirements for a high temperature system. Wright Air Development Center introduced a new fluid, MIL-0-8200, which would do the job, except that no sufficiently flexible compatible synthetic materials were available to seal at —65 F. Lacking a compatible seal, a variation of MIL-0-8200 was chosen for the B-58. It is a silicone oil, 85% silicate ester and 15% diester. Density is 7.85 pounds per gallon. The flammability characteristics are flash point 390 F, flame point 450 F, and



CADMIUM PLATE SPECIMENS, after exposure to special high temperature fluid, show why this material must be avoided.

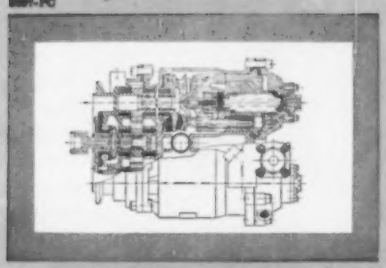
Circle 123 →

PESCO SPECIALISTS DESIGN 2 IN 1 HI-TEMPERATURE HYDRAULIC PUMP FOR FAIL-SAFE OPERATION!

The environmental factors of supersonic performance necessitate new concepts of dependability in air weapon subsystems and components. To meet the requirement for fail-safe operation, PESCO engineers have created a new *dual-element high-temperature pump for main hydraulic systems.* This advanced design features two independent pumping elements housed in a single body and driven by a common shaft. Failure of either element does not affect over-all performance because *each is capable of meeting the system's flow requirements.*

This dual element design exemplifies Pesco's creative engineering capabilities for specialized high-temperature hydraulic pumps and motors. Precision units featuring fluid temperatures to 550°F and over-all efficiencies of 90% can be supplied to meet your specific requirements. *For details, call your nearest Pesco representative or write direct.*

8897-PC



Operating on 25-100 psig inlet press. and 550°F inlet temp., this PESCO Dual Element Design discharges 21.5 gpm at 4000 psi.

PESCO PRODUCTS DIVISION
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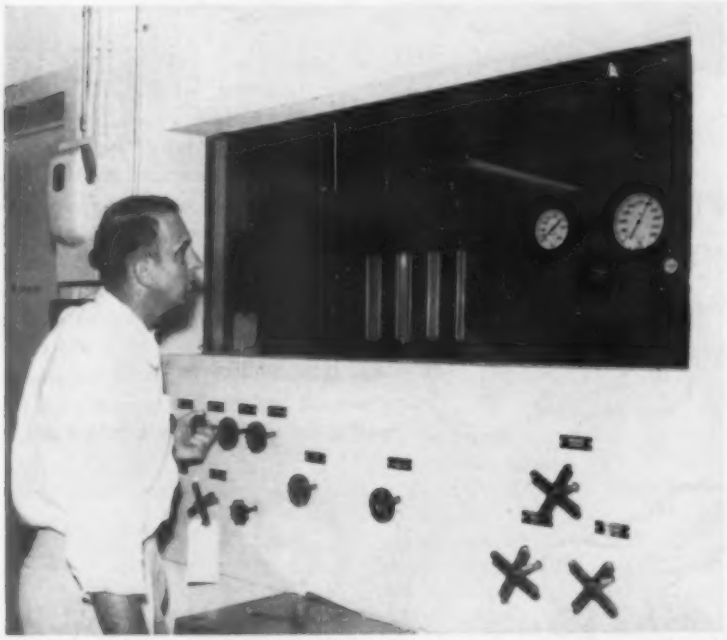
B-W

Creative Engineering for the Space Age

EXPORT SALES: Borg-Warner International Corp., 36 South Wabash Avenue, Chicago 3, Illinois

autogenous ignition temperature 760 F.

• **Oxidation**—This fluid deteriorates at high temperatures when exposed to oxidizing conditions. Systems must be designed to exclude all air possible for operations beyond 160 F. To prevent gas entrapment in the fluid, reservoir capacities must be adequate for system flow. Internal reservoir centrifuges, extended "dwell" design, or other devices may be necessary to maintain a gas-free supply of fluid.



REMOTE CONTROL for testing high-temperature hydraulic systems reduces hazards to operating personnel.

WHAT'S NEEDED IN A HIGH TEMPERATURE FLUID?

High temperature stability is the most important property of hydraulic fluids in the advanced aircraft and missile field. Shear and pressure resistance are also required for hot fluid application. If air can be totally excluded from the system, the oxidative stability of the fluid is not very important. Solid impurities cannot be tolerated because they would clog the filters and make the servo valves malfunction.

High temperature systems require good fluid lubricity, but new component design and materials can compensate. Deficiencies in viscosities, volatility, foaming, flammability, and bulk modulus can similarly be overcome by component modification. Presently, 700° F is the maximum operating temperature for organic fluid systems. A major breakthrough in organic chemistry will be needed to develop a 1000° F fluid with the desired viscosity and volatility.

Currently, such compounds as selected petroleum fractions, silanes, silicones, esters, and metallo-organic fluids show the most promise for application below 1000°F. For higher temperatures, gases and liquid metals show the greatest possibilities. These will demand new approaches to system and component development to cope with the fluid power requirements of more sophisticated aircraft and missiles.

From an ASME Paper presented by R. L. Leslie, Vickers Inc.

• **Flammability**—Although fire resistant, the fluid will ignite when sprayed into an atmosphere of 495 F. from pressure in excess of 1,000 psi. Avoid routing lines and connections through hot spots and install parallel safety cut-offs and visual warning devices.

• **Hydrolysis**—Moisture contamination of this fluid (above 500 ppm) must be avoided because a silica gel precipitate may be formed. Atmospheric humidity is the greatest source of water contamination, and only clean dry nitrogen should fill the non-fluid volumes in the containers.

• **Materials Compatibility**—Materials containing cadmium or calcium should not be used. Teflon is highly stable as a high temperature sealing material. Of the synthetic rubbers neoprene WRT has general application although it suffers cumulative damage by heat. To flush the system, use only the fluid itself. Sealing compounds based on epoxy plastics are compatible with this fluid. A sealing nut with a Teflon insert for pipe threads is said to prevent leakage to 10,000 psi at temperatures to 500 F.

• **Fluid Replacement**—Severe operating conditions dictate the need for frequent fluid analysis to determine the time for replacement. Low viscosity has been the usual index for replacement. Limits of 6.0 centistoke at 210 F for used oil, and 8.4 cs for new oil are the criteria. Fluid costs about $23. per gallon.

• **Hazards to Personnel**—Tissue rupture and burns are the main dangers to people working with high temperature high-pressure systems. Design control panels and operator positions to minimize exposure. Provide protective clothing where necessary. Toxicity is not excessive and requires only the normal irritant protection.▼▼▼

Circle 154 →

From the present USAF production ATLAS
CONVAIR has developed a

Basic Research Vehicle

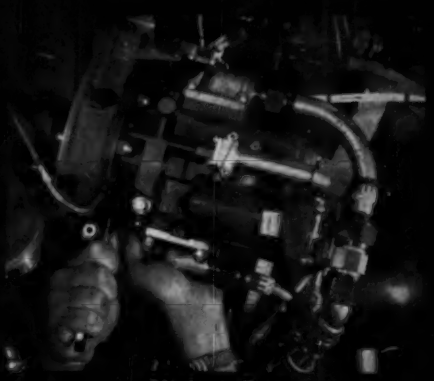
...a missile booster for peaceful scientific space exploration

VICKERS INCORPORATED supplies hydraulic pumps which provide reliable power for the vital job of gimballing all engines on the mighty Atlas. These pumps are part of a complete line of fluid power equipment with an industry-wide reputation for thorough engineering and precision manufacturing.

VICKERS, as a result of its participation in missile and spacecraft programs, has developed cryogenic, hot gas and other types of auxiliary power systems. Also available: electrical generating systems, actuator systems, and miniaturized power packages with integral controls.

Call in your Vickers Application Engineer to discuss your airborne fluid power requirements... components or systems.

Write for Bulletin A5233



Vickers Pump Being Installed on Atlas

AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
DETROIT 32, MICHIGAN

division of
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464

AVIATION NEWS

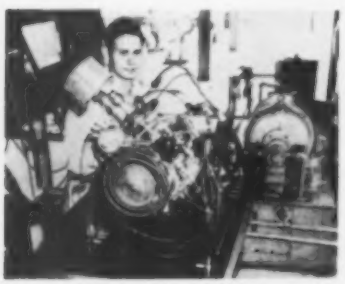
from the fluid power field

Moog Servocontrols, Inc., has established a west coast design group to study new products for aircraft and missiles. **James Hager** will head the group. The design and development group will also service components for the west coast.

The hydraulic department of **Bendix Aviation's** Pacific Division will develop transporter-erectors for the Minuteman ICBM. The equipment will haul the missile from storage to launch site, lower it into its launch silo, and erect it.

COMPACT COMPRESSOR FOR PERSHING MISSILE

Weighing only 30 pounds, this new compressor, designed for ground support of the Army's Pershing missile, can deliver 12 scfm of air at 3000 psi at sea level.



Its casing is 18 inches in diameter and about 12 inches long. The four-stage compressor can be driven by either an electric or hydraulic motor. **Stratos Division** of the **Fairchild Engine & Aircraft Corp.** expects to deliver the production prototype to the Army soon.

Philip W. Morse has been advanced to sales manager for aviation and missile products made in the Cleveland plant of **Weatherhead Co.** Before joining the company, he was sales manager for Magnethermic Corp., and served 11 years with General Electric Co. in sales, application and development engineering.

Sargent Engineering Corp. of Huntington Park, Cal., has established an acoustics laboratory to study noise reduction on hydraulic and mechanical equipment. They are developing quieter hydraulic metering units to provide a basis for meeting the critical valve noise specifications. Tests include spectrum level and frequency analysis.

Frederick O. Hosterman, president and general manager of **Weston Hydraulics, Ltd.,** of Van Nuys, Cal., has received the Alumni Merit Award from St. Louis University. From 1954 to 1957 he was a member of the Aircraft Advisory Committee to the Assistant Secretary of Defense for Research and Development. Among his professional activities, he has served for three years as a member of the Aircraft Editorial Advisory Board of APPLIED HYDRAULICS & PNEUMATICS.

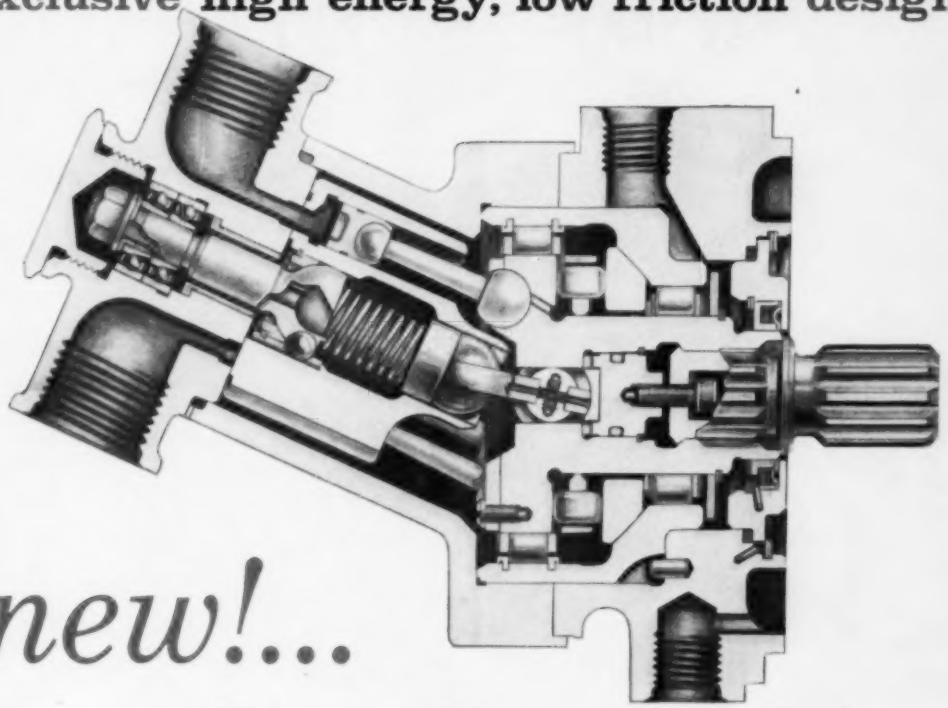
James P. Malmstrom has been appointed assistant to the president of **Koehler Aircraft Products Co.,** Dayton Ohio. He will have administrative and liaison duties on missile and advanced aircraft component contracts. Before joining Koehler, Malmstrom was Vice President of United Aircraft Products Company.

Nicholas F. Pedersen has joined the Aero Hydraulics Division of **Vickers, Inc.,** Detroit, Mich, as executive engineer in charge of major programs. For three years before joining Vickers, he served as design engineer in charge of hydraulics at Hamilton Standard Div., United Aircraft Corporation. His background includes five years as chief design engineer with the Swaging Machine Division of Torrington Co., and four years as assistant professor of engineering at Trinity College.

Pedersen

Hydraulic control systems for the Pershing missile will be designed and built by **Kearfott Co., Inc.,** a subsidiary of General Precision Equipment Corp. Each plug-in system will control rate and angular postion of two synchronized, output shafts which drive control fins. Modular construction will contain motor-pump, electrohydraulic servo valve-actuator, and accummulator-reservoir sections. Work will be done at Kearfott's Airborne Hydraulics Laboratory.

exclusive high energy, low friction design



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hydraulic
motors and pumps

with** basically new **design features
offering** basically better **performance!

Here is important news for hydraulic design engineers. The Cornelius Company is pleased to announce development of a new line of hydraulic motors and pumps that are lighter, more efficient and more compact. The exclusive, new **high energy, low friction** design of this equipment is possible because of Cornelius inventions. Nine U.S. and foreign patents covering these products have been issued to date.

If you have unsolved problems in hydraulic motors and pumps or are not entirely satisfied with the performance you are now getting from your present equipment, be sure to investigate these new Cornelius products. These new Cornelius pumps and motors can be tailored to meet your system requirements.

Free — Product Data Bulletin No. 25 describes Cornelius Aero Hydraulics equipment; includes installation information, specifications and performance data. Write today.

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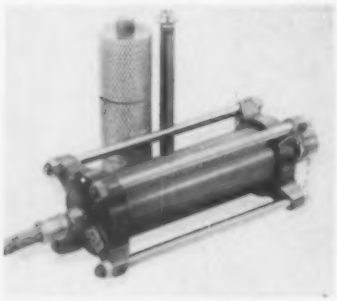
Qualified individuals will find excellent opportunities available in Cornelius engineering and sales departments.

AIRCRAFT COMPONENT DATA

3-Micron Filter . . . for service carts

Attaches to outlet connection of MIL-H-5606 and MIL-H-8446 service carts. The first two stages



have ultrafine fiberglass and membrane packed into a throwaway cartridge. The third stage has a corrugated, sintered woven wire mesh element which provides 98%, 5-micron filtration, and absolute, 18-micron filtration, even without primary cartridge.—*Aircraft Porous Media, Inc., Glen Cove, N. Y.*

Circle **500** on Time-Saver Card

Servo Actuators . . . use mechanical feedback

Simple mechanical feedback eliminates electrical feedback transducer and amplifier. Actuators have

excellent linearity and resolution for missile and spacecraft control. Product bulletin 107 describes operation and performance characteristics.—*Moog Servocontrols, Inc., East Aurora, N. Y.*

Circle **501** on Time-Saver Card

Servovalves & Actuators . . . for missiles

For high-performance applications under extreme environmental conditions. Rotary or linear actuators. Brochure covers remote servo systems, rotary switches, repeater and servoed indicators.—*Electromechanical Div., Kearfott Div., General Precision, Inc., Little Falls, N. J.*

Circle **502** on Time-Saver Card

Tube Fitting . . . metal sealed

Metal-to-metal port seal is vibration and shock resistant. Available for ¼" to 2" O.D. tubing in aircraft quality 321 stainless steel.

Service from 28" vacuum through 5000 psi, from —270 F to 1200 F. 360-degree positioning of fitting with lock nut tightening.—*Paragon Manufacturing Co., Cleveland, Ohio.*

Circle **503** on Time-Saver Card

Variable Delivery Pumps . . . have fixed angles

Rotation of valve plate's inlet and outlet ports varies delivery of axial-piston pumps. Volumetric efficiencies from 96% to 98% over 500-3000 psi range. 4000-psi continuous operation. Meet 750 hours at rated rpm per MIL-P-19692. Integral, automatic pressure compensator. Two types of control: nearly constant hp from zero to full flow; selected pressure drop from zero to full flow, to match system requirements. Specialized pumps available. Major parts interchangeable within fixed and variable pumps, motors. Bulletin A5233A has schematic of pumping components, performance table and curves, application photos.—*Aero Hydraulics Div., Vickers, Inc., Div. Sperry Rand Corp., Detroit, Mich.*

Circle **504** on Time-Saver Card

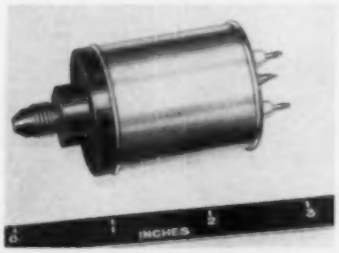
Reinforced Diaphragms . . . for 500 psi

Brochure describes variable area (free loop) and constant area (full radius) diaphragms. For temperatures from —65 to 500 F.—*Stillman Rubber Co., Culver City, Calif.*

Circle **505** on Time-Saver Card

Pressure Switch . . . for wide temperature range

For continuous duty from —65 to 1000 F 20 to 200 psi. 10% accuracy. All-welded construction of



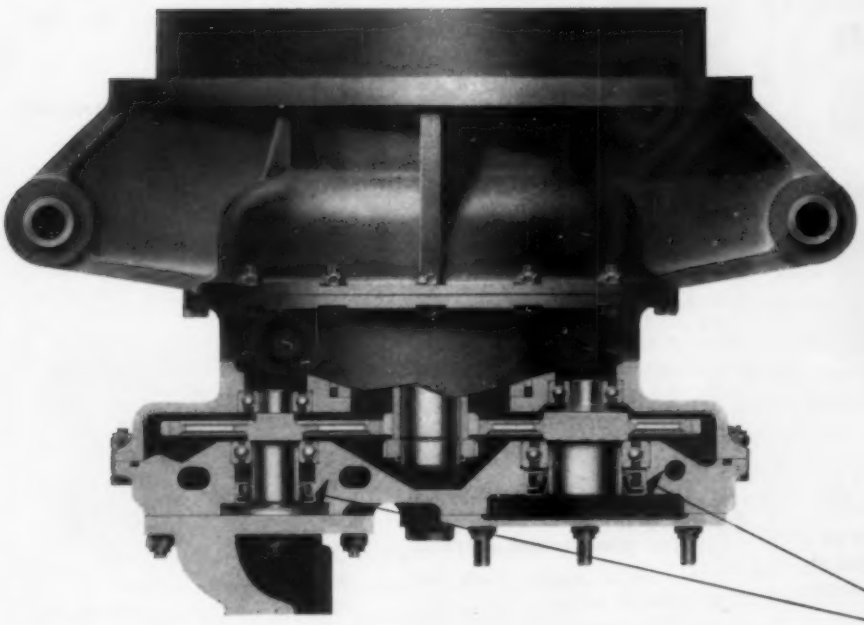
Inconel and Inconel-X permits wide temperature operation.—*Consolidated Controls Corporation, Bethel, Conn.*

Circle **506** on Time-Saver Card

Continued on page 124

NATIONAL® OIL SEAL LOGBOOK

In Titan's first and second stages



Aerojet-General solves sealing problem on shafts accelerating 0 to 3,800 rpm in 1 second

Zero to 3,800 rpm in 1 second, on 1" band 1½" shafts. Synthetic-base lubricant to retain. Magnesium housing. Operating temperatures —65° F to 300° F. Utmost dependability an absolute essential. These are typical of operating conditions in the turbopump gear boxes of the first and second stages of the Titan missile.

Aerojet-General and National Seal engineers answered the shaft sealing problem on the 3,800 rpm shafts by adapting a standard-design National Oil Seal. The seal's outer case is aluminum for light weight and to match closely the coefficient of expansion of the magnesium housing. The tensioning spring is stainless steel, unaffected by synthetic lubricants. The single-lip sealing member is a specially compounded Buna N synthetic rubber, specifically designed for use with the synthetic-base lubricant.

National offers over 2,500 different standard design oil seals; provides special seals for special applications. For complete information or sealing engineering assistance, call your National Applications Engineer. He's listed under Oil Seals, in the Yellow Pages.

NATIONAL SEAL

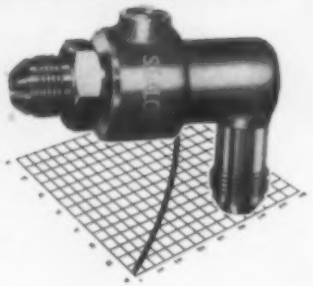
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio; Downey and Redwood City, California.

5661

SEALOL SWIVELS

Save Space
Cut Power Loss

for example...



6 G.P.M. **at 3,000 P.S.I. aircraft-type swivel illustrated in ½" O.D. tube size. Extremely low swiveling torque (10 inch-pounds at 3,000 P.S.I.) means minimum power loss. Meets or exceeds MIL J-5513A.**

and then...

600 G.P.M. **special, multi-passage fuel transfer swivel shown for use with JP-4 and similar fuels. Flow rate 600 G.P.M. at 50 P.S.I.G., pressure drop less than 3.2 P.S.I., 18¼" C. to C. of end passages.**

Write or phone S. Biello for further details — STuart 1-4700
(for direct distance dialing, area code is 401)

SEALOL CORP.

153 Post Road
Providence 5, R. I.

Circle **135** on Time-Saver Card

AIRCRAFT COMPONENT DATA

Dual Piston Pump
. . . operates on either piston

Hydraulic pressures to 4000 psi, at temperatures to 550 F, can be maintained with only one piston.

Eliminate emergency hydraulic system. The new pump normally delivers 22.5 gpm with a displacement of 1.012 cu. in./rev. Single-piston operation reduces flow by 50%. Model 013673-010—*Pesco Products Div., Bedford, Ohio.*

Circle **507** on Time-Saver Card

Sampling Kit
. . . for pressurized systems

Takes liquid samples, finds particle contamination. Disposable, plastic filter holder with filter disc provides closed sampling system. Sampler is plugged into system. System's operating pressure forces

sample through filter into graduated polyethylene bottle. All particles retained on filter's surface. Kit has necessary adapters and connections, metal syringe, 2-way valve, 48 filter holders.—*Millipore Filter Corp., Bedford, Mass.*

Circle **508** on Time-Saver Card

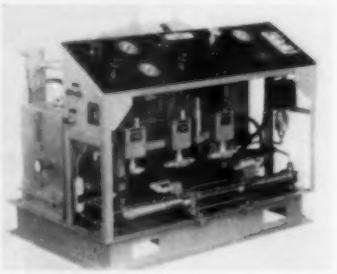
Stainless Steel Filters
. . . to 10,000 psi

Release M-212A describes porous elements of cylinder, bayonet, star, and custom configurations. In 316 and 347 ss, nickel, Monel, Hastelloy C, Inconel, and Stellite L-605. Up to 50% of filter sheet volume consists of interconnecting pores. Square foot of 1/16" Grade D pourous stainless steel passes 330 cfm of pure air, at .1-psi pressure differential. Container is 304 ss (or alloy matching element). Container pipe sizes are ¼", ½", and 1" NPT.—*Micro Metallic, Div. Pall Corp., Glen Cove, N. Y.*

Missile Compressor
. . . needs no lubricant

Circle **509** on Time-Saver Card

Gas booster compressor is two-stage, with a 12:1 ratio. Compressor output is 16 scfm at 1000-psi inlet, to 28 scfm at 2200-psi inlet pressure, with discharge pressure of



6000 psi. Hydraulic drive automatically compensates for changes in inlet pressures, eliminating pressure regulator. Model SS-III.—*Haskel Engineering & Supply Co., Glendale, Cal.*

Circle **510** on Time-Saver Card

Dehydration Cartridge
. . . for missile charging

Mechanical filter, disposable cartridge, purifier removes water vapor and other contamination. Cross-section diagram shows arrangement and operation. This equipment is used in missile charging systems, and pneumatic and hydraulic system charging.—*Robbins Aviation, Inc., North Hollywood, Calif.*

Circle **511** on Time-Saver Card

Pressure Transducer
. . . is flush-mounted

Type 4-327 in pressure ranges from 0-100 to 5000 psig and psia. Easily measures high-frequency

Continued on page 126

New Hydraulic Filter

Removes particles of all sizes to practically zero Microns

...tests with Aircraft & Missile hydraulic oils show MICROCELL 99.99% *effective*

At last here is a hydraulic filter that has been *proven in the field* to remove all particles down to practically zero microns!

Luber-finer, Inc., with 25 years experience in oil refining and filtration design and development, combined its "know-how" with years of testing to produce the Microcell filter for the aircraft and missile industry. For the past three years the performance of the Microcell filter has been proven in the field on hydraulic test stand applications and on mobile and portable service units.

Now Luber-finer, Inc. is satisfied with its performance record. Independent laboratory tests show the Microcell removes about 95% of everything down to 2 microns in one pass. After additional passes or circulations through the filter, 99.99% of everything down to practically zero microns can be removed. Microcell filter is now ready for wider distribution to companies in need of such extremely fine micronic filtration, offered for the first time by the Microcell.

Tests have also proven that the Microcell filter will not adversely affect the characteristics or performance of the oil. It actually improves operational performance through more thorough dispersion of the additives.

Another advantage of the Microcell filter is its ability to carry a heavy captured dirt load and still perform efficiently without plugging up. One Microcell Pack can remove and hold up to 150 grams of contaminants from hydraulic oils and still perform efficiently.

Mail the coupon today for more free information about the revolutionary Microcell—including graphs of performance characteristics, 200× magnification photos of various stages of filtered oil, installation drawings, etc.

Here are some of the users of the Microcell filter on test stands and mobile service units.

Rocketdyne Division
North American Aviation, Inc.
Chatsworth, Calif.

Raytheon Manufacturing Co.
White Sands, New Mexico

Aerojet General Corp.
Azusa, Calif

Republic Aviation Corp.
Long Island, New York

Vickers Incorporated
Torrance, Calif.

The Hufford Corporation
El Segundo, Calif.

Luber-finer
INCORPORATED

LUBER-FINER, INC., Dept. J-1
2514 South Grand Avenue
Los Angeles 7, California

Please send complete information on your new Hydraulic Filter which has been proven 99.99% effective in removing all particles down to practically zero microns.

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ADDRESS

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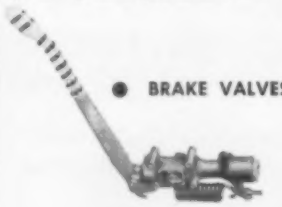
RELIABILITY
AND
PERFORMANCE
are our main products

First, imaginative design; then experienced thoroughness through development, tooling, production, assembly and tests, all under strict quality control in an unusually well equipped plant . . . we can help you solve your special problems . . .



- BRAKE VALVES
- TRANSFER VALVES

- RELIEF VALVES

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also

- SOLENOID VALVES
- SELECTOR VALVES
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- PRESSURE REDUCERS
- FUEL PUMPS
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WRITE, wire, or phone for data, quotations and service.

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Circle **98** on Time-Saver Card

AIRCRAFT COMPONENT DATA

transient phenomena. Provision for adjustment of bridge balance, temperature compensation, and sensitivity external to the unbonded, strain gage testing element. For missile test stands, aircraft and missile engine test cells, high-pressure

pneumatic systems, and nuclear reactors.—*Transducer Div., Consolidated Electrodynamics Corp., Pasadena, Calif.*

Circle **512** on Time-Saver Card

Sonic Flow Nozzles . . . accuracy tolerance less than 2%

Operate on critical flow principle. Find mass rate of air flow. Calibrate other meters. Set shown is made into 1" unions. Covers .05

to 20.0 lb./min. (.66 to 267 scfm). Other ranges and connections available. Instructions, calibration furnished. Uncalibrated nozzles available.—*Flow-Dyne Engineering, Ft. Worth, Texas.*

Circle **513** on Time-Saver Card

Flow Regulator . . . for liquids and gases

Less than 50 millisec. from lock-up to full flow, and vice versa. Can be regulated with 15-psi differential between supply and regulated pressures. Zero leakage with clean media. Constant pressure from zero

to full rated flow. Operating pressure ranges are 0 to 8000 psi. Adjustable from 8 psi to full inlet pressure.—*Solrac, Inc., North Hollywood, Calif.*

Circle **514** on Time-Saver Card

Pressure Gage . . . has permanent accuracy

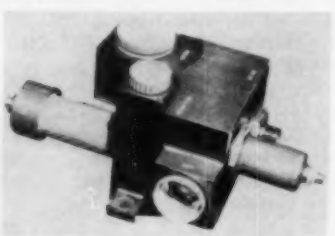
Needs no maintenance or recalibration throughout life, even under extreme shock, vibration, and pressure surges. Calibrated by dead

weight tester to .25%. Ranges from 0-100 to 0-10,000 psi. 6" dial. Mirror reflection band behind needle eliminates parallax error. Bourdon tube is only moving part.—*Glassco Instrument Co., Pasadena, Calif.*

Circle **515** on Time-Saver Card

4000-psi Valve . . . relief, reducer, check

No. A-70918 for hydraulic fluid per MIL-O-5606. Adaptable for



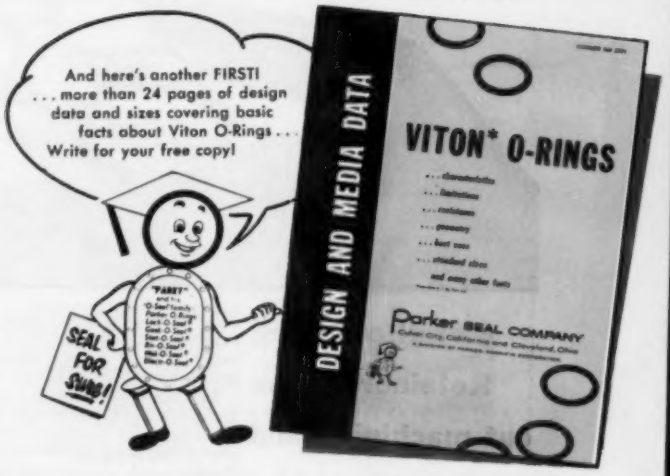
other hydraulic fluids. Temperature range is —65 to 275 F.—*Vinson Engineering & Sales Corp., Van Nuys, Calif.*

Circle **516** on Time-Saver Card

Continued on page 128

NOW— VITON O-RINGS IN ALL A.N. OR A.R.P. STANDARD SIZES

One of the first to embark upon a research and development program for Viton O-rings, Parker Seal Company now makes another significant advance in this versatile high temperature material by offering Viton O-rings in all A.N. or A.R.P. standard sizes. This means faster delivery and greater economy for all these popular O-ring sizes. It's another plus result of **responsible leadership** *in O-ring engineering by Parker.*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Parker SEAL COMPANY

Culver City, California and Cleveland, Ohio

A DIVISION OF PARKER-HANNIFIN CORPORATION

Circle **120** on Time-Saver Card

Circle 1 on Time-Saver Card

Fall Wiper Ring SPRING LOADED

The Fall "CJ"* Wiper-Scraper Ring is Spring-Loaded causing Squeeze-Grip Action on the O.D. of the piston rod during entire cycle. This patented feature maintains a uniform, continuous pressure on the wiping edge of the ring at all times, stopping any buildup of foreign matter between the ring and the rod.

It automatically takes up wear, maintaining NEW RING PERFORMANCE. Available in diameters ½" through 13" for any commercial use. AN and MS numbers in use by the Military and Aviation industry since 1944. Manufactured in accordance with MIL-S-5049. (*Closed Joint)

ACE PRODUCTS CO.

1820 N. 12th St. Toledo 1, Ohio
Est. 1935

AIRCRAFT COMPONENT DATA

Pressure Reducer . . . is miniaturized

Gas at 3000 psi can be reduced to any pressure from 300 to 1800

psi by selecting proper spring. Weighs only 8 ounces. Dimensions are 2-13/32" x 2-3/16" x 1-7/32". Suitable for auxiliary power systems.—*Walter Kidde & Co., Belleville, N. J.*

Circle **517** on Time-Saver Card

Shut-off Valve . . . is inertia-actuated

Normally open valve closes only at a preset loading. Flow rate is

9 gpm with a maximum pressure drop of 0.5 psi. Supplied in any line size, Model 35-2064-000.—*Aero Supply Mfg. Co., Inc., Corry, Pa.*

Circle **518** on Time-Saver Card

Quick Disconnect Coupling . . . for missiles

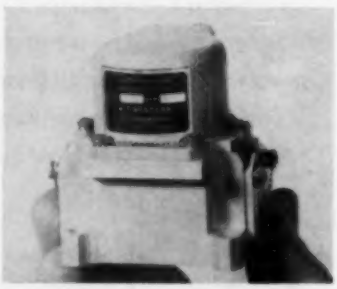
2" coupling P/N 5-1052-32, has pressure-balanced valving for use

at 3000 psi with no fluid loss or air entry. Jaws that grip the mating half like a collet give positive locking.—*Mark Couplings, Inc., Los Angeles, Calif.*

Circle **519** on Time-Saver Card

Servo Valve . . . weighs 9½ oz

Rated flow is 5 gpm at 1000 psi. Maximum internal leakage, .09 gpm. No external leakage. Large



control orifices and clearances, and high driving forces insure long life and reliability.—*Midwestern Instruments, Tulsa, Oklahoma.*

Circle **520** on Time-Saver Card

NEW! FROM UNITED

Metallic O-Ring Retainer Plates cut machining and assembly costs!

Now mating flanges can be sealed without machining grooves to hold metallic O-rings! United's metal retainer plates can be made for most junctures, regardless of the number of ports.

Openings in retainer plates function the same as groove walls. They furnish O-ring compression limit, control O-ring hoop tension, position O-rings for accurate matching of multiple hole patterns in mating flanges, and permit interchangeability of flanges. For price quotations, send flange drawing and specifications for fluids, pressures and temperatures to:

Circle **148** on Time-Saver Card

Circle 72 on Time-Saver Card

NOW MINIATURE HAYDON PRESSURE SWITCHES

ADDED TO STANDARD 1500 SERIES ADJUSTABLE PRESSURE SWITCH LINE

(6 oz., 3-7/8" x 1-5/16")

1580 & 1880

The 1580 *Miniature Gage* Pressure Switch (4 ounces maximum, 3" x 1½") and the 1880 *Miniature Absolute* Pressure Switch (4 ounces, 3¼" x 1½") have SPDT or DPDT circuitry, with either sealed or unsealed snap-action switches. Operating pressure range: 0.5 psi to 3,000 psi. Operating media: Ammonia systems, freon, lubricating and hydraulic oils, aircraft fuels, radioactive water, oxidizers.

Write now for Bulletin 1580-1, which gives design specifications, electrical & environmental data, and applications.

HAYDON Switch INCORPORATED
WATERBURY 20, CONNECTICUT

Make a good valve even better!

HADBAR bonded fluorosilicones improve component reliability in missile check-out systems. The bonded seal on this valve is resistant to fuels, nitrogen and helium...is compatible with LOX cleaning methods...functions in a temperature range of —80°F to +300°F. HADBAR may have the answer to your specific requirements in molded, extruded and bonded applications.

HADBAR INC.

9530 Gidley Street, Rosemead, California CU 3-4121
Northwestern Representative:
101 Jones Building, Seattle 1, Washington

Circle 67 on Time-Saver Card

Too bad the Dutch Boy never had it so leakproof!

CIRCLE SEAL CHECK VALVES

A finger in the dike may have solved the Dutch Boy's dilemma but today's precision-minded engineers insist on *complete leak-proof* performance for their sealing problems. That's why engineers specify Circle Seal.

Put your finger on the perfect solution to leak-proof check valve performance. Circle Seal check valves will meet your requirements in pressures from 0-10,000 psi for nearly all types of service —liquid or gas. Positive sealing at any differential pressure. Quick opening—positive closing. Maintenance-free dependability. You don't need a Dutch Boy when you specify Circle Seal Valves!

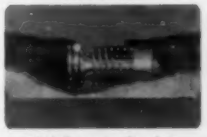
200 Series

Standard Service
0 to 3000 psi

100 Series

Ultra Sensitive Service
0 to 25 psi

2300 Series



High Pressure Service
0 to 10,000 psi

Cartridge Type

Manifold Block
Assembly Mounting

Military Service:
JAMES, POND & CLARK, INC.
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CIRCLE SEAL PRODUCTS CO., INC.
2181 East Foothill Blvd., Pasadena, Calif.

CIRCLE SEAL
precision valves

Circle 36 on Time-Saver Card

Remove damaging oil, water and dirt from compressed air lines...

NEW WILKERSON "WHIRLFLO"

For air lines 1/4" to 5" P. T. with or without pipe flanges.

Exclusive features of
NEW WILKERSON "WHIRLFLO" FILTER

★ Metal bowl or transparent bowl which permits you to see condition of cartridge and when to drain.

★ "Micro-Pruf" cartridge completely removes oil and particles as small as 3 microns—lasts 4 times longer.

★ 200% greater CFM capacity. Maximum pressure 250 PSI with metal bowl.

SAVE ON
maintenance & operation

1. The cartridge lasts 4 times longer than others.
2. Cartridge is easily replaced by removing one nut while unit remains on pipe line.
3. Addition of automatic petcock eliminates human failure to drain, keeping cartridge from water level.

Put the "WHIRLFLO's" double-barrelled action to work for you.

1. Centrifugal force from special baffle vane sends contaminants to walls of cylinder away from cartridge, from where they drain into sump.

2. Then separated air flows through "Micro-Pruf" cartridge. This 2-stage action cleans better and adds months of life to cartridge.

WRITE TODAY for your **FREE** copy of new 24-page color coded Wilkerson Catalog #158.

WILKERSON CORPORATION

Dedicated to keeping the NEW in pNEUmatics

1643 WEST GIRARD, ENGLEWOOD, COLORADO

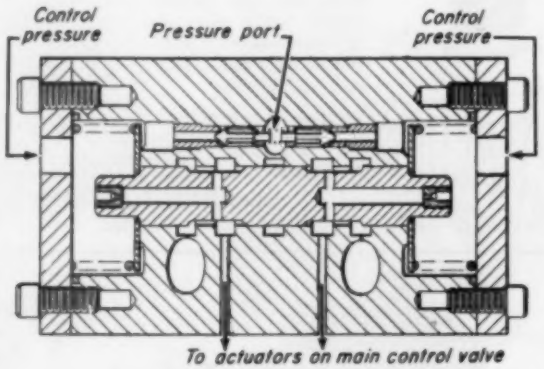
Circle **164** on Time-Saver Card

FLUID POWER PATENTS

Impulse-Actuated Control Valve

The valve is used as a pilot valve to direct fluid to and from the actuators on a larger control valve. Opposing springs keep the valve in neutral. A momentary fluid impulse moves the valve from its seat. This movement opens a port, and pilot pressure drives the valve wide open.

• **Operation**—An impulse of pressure liquid at the right control port moves the valve spool to the left. The orifice in the spool provides enough back pressure to



overcome the force of the spring at the other end of the valve. As the spool moves to the left, its right land covers the exhaust port and its center land uncovers the pressure port. Pressure flows through the spool and the orifice to the right control chamber, driving the spool left.

The small check valve in the valve body allows fluid to escape from the left control chamber.

The valve operation is reversed by applying a pressure impulse to the left control chamber.

U. S. Patent No. 2,882,931 *by Frank H. Towler, and Rodley & John Towler. Assigned to Electraulic Presses Ltd., Rodley, England.*

Four-Pressure Relief Valve

This compact relief valve has four pressure settings. It works by directing pump pressure to different plunger areas. There are two shutoff valves needed in the relief valve circuit.

The drawing shows the valve controlling pressure to a fluid motor. With both shutoff valves closed, the spring control piston retracts and pump pressure acts on the area of the small plunger.

Continued on page 132

Circle **14** on Time-Saver Card

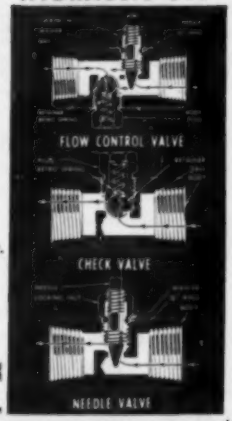
Get Easier, More Accurate Cylinder Speed Control

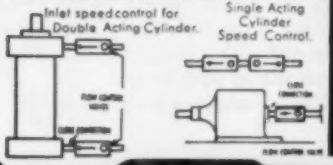
with **Pneu-Trol®** VALVES IN AIR OR HYDRAULIC USE

2,000 (brass or aluminum) and 5,000 (steel) p.s.i.

Pneu-Trol Valves combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to seat, requiring only a slight differential pressure to fully open or close it. Check Valve and Needle Valve incorporate single function features of Flow Control Valve. All valves available in 5 female pipe sizes — 1/8" to 3/4". Valve bodies are made from brass, aluminum, steel or stainless steel. Attractive Prices — Immediate Delivery.

Write for Illustrated Circular and Price List.





AUTO PONENTS INC
2919 GRANT STREET
BELLWOOD (Chicago Suburb) ILLINOIS

TRU-FLATE

THE "JET" MOST EFFECTIVE AND ECONOMICAL AIRLINE BLOW GUN AVAILABLE

Eliminates Hand and Finger FATIGUE

MODEL NO. 404 X

1.75 DEALER NET

An all-purpose blow gun with "positive" finger tip control — can be quickly and accurately adjusted from a mere whisper to a full scale blast of air by a slight turn of the nozzle. You get just the right amount of air, at the right time, at the right place.

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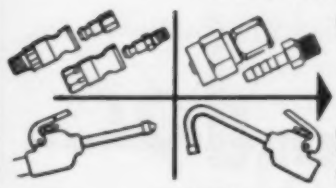
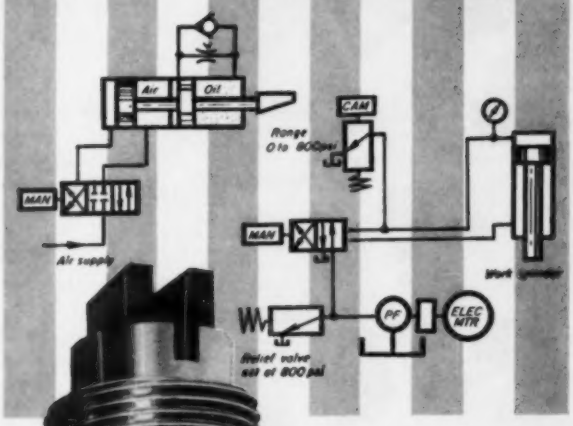
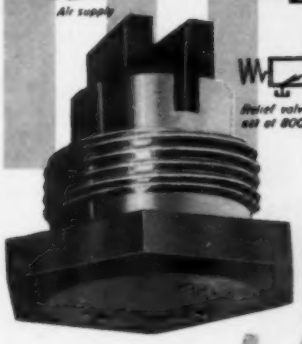


- Couplers and Nipples
  - Sleeve Type Series
  - "Push" Type Series
  - Interchange Series
  - Hydraulic Series
  - "Strait-Thru" Series
- Reuseable Hose Fittings
- Barb Type Hose Fittings
- Blow Guns, Water Valves

Circle **146** on Time-Saver Card

HYDRAULIC SYSTEMS PERFORM BETTER





with **LISLE** *Magnetic* **PLUGS**

Fouled valves and excessive pump wear are frequently caused by abrasive ferrous metal particles that are circulating in the fluid of a hydraulic system.

You can eliminate this problem by installing a Lisle Magnetic Plug in the flow path or sump. The powerful magnet in the Lisle Plug attracts and holds these ferrous particles; assures better performance of the entire hydraulic system.

LISLE CORPORATION
CLARINDA • IOWA

Write for Catalog and Test Samples.

Circle **94** on Time-Saver Card

You can use the "natural reservoir" of air pressure!

To the Product Designer, the air around us offers a unique opportunity. No other material is available everywhere on earth. In the atmosphere's natural reservoir, air exists only under pressure (about 14.7 p.s.i., sea level). Remove some of it from a confined space with a vacuum pump and this reservoir of low pressure starts to work.

Often, a specific task cannot be performed in any other way due to the shape, size or location of the work. Nature's pipeline of air is always full, surrounding the work area so that vacuum (negative pressure pneumatics) is the simplest — and sometimes the only — means of attack. In using the vacuum pumps we build, engineers continue to surprise us with ingenious applications for vacuum.

For example, they lift parts as small as bottle labels and as large as 2,000 lb. steel sheets. They hold and feed paper tape as well as large metal sign blanks. They convey solids, sample gases, test for leaks, mold plastic sheets and position parts with vacuum.

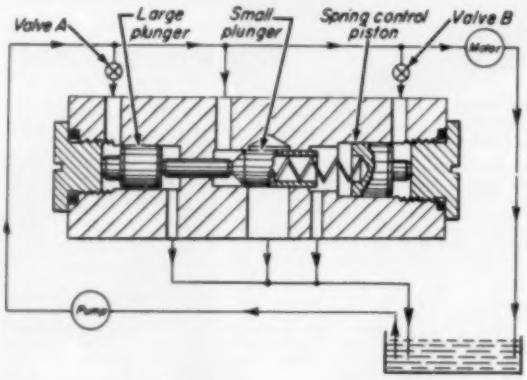
We could go on — but instead, why don't you request our booklet, "Application Ideas"? Or literature on air motors, compressors or vacuum pumps? (If you can, specify capacities.) We'd like to help *you* benefit from that "natural reservoir" of air pressure — to better your product's function or performance. *Write us today.*

Gast Manufacturing Corporation, P.O. Box 117-D, Benton Harbor, Mich.

Circle **61** on Time-Saver Card

FLUID POWER PATENTS

When valve *A* opens, pump pressure acts on the combined area of the large and small plungers. The valve relieves at a lower pressure.



When valve *B* opens, the spring control piston extends and increases spring force. The valve now has two additional pressure settings: a high setting with valve *A* closed, and a low setting with it open.

Valve settings for the four pressures are given in the table.

		VALVE A	VALVE B
Low ↓ High	1	Open	Closed
	2	Closed	Closed
	3	Open	Open
	4	Closed	Open

No. 2,890,715 by Robert C. Ebersold, assigned to Warner & Swasey Co., Cleveland, Ohio.

Other Patents Issued

AIR LINE LUBRICATOR

No. 2,887,181 by Wendell M. Dillon, assigned to Watts Regulator Co., Lawrence, Mass.

AIR LINE LUBRICATOR

No. 2,889,009 by Peter J. Endebak, Gilbert Riske, and Warren R. Tucker, assigned to Parker-Hannifin Corp., Cleveland, Ohio.

SHAFT SEAL

No. 2,889,159 by Hans Jensen, assigned to Gits Bros. Mfg. Co., Chicago, Ill.

VANE-TYPE PUMPS

No. 2,892,584 by Emanuel S. Briscoe, Oklahoma City, Okla.

VALVE ACTUATOR

No. 2,892,611 by John Birkmaier, Franklin Square, N. Y.

BARKSDALE AIR-SEAL* VALVES

LOW PRESSURE AIR TO 250 P.S.I.

. . . over 200 different valves available.

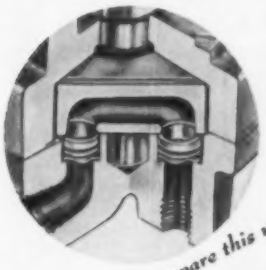
*The air pressure is the sealing force . . .
the higher the pressure,
the tighter the seal.*

Why so many different air valves?

Because air valve requirements vary with the method of actuation. A basic valve with interchangeable actuators cannot possibly meet ALL your specific applications without compromise. For example: A solenoid valve designed for speed would not have the stamina required of a manual or foot valve.

The Barksdale line of AIR-SEAL Valves has been designed with your requirements in mind. All our valves have been engineered for best performance from your point of view . . . for YOUR specific need, and not to make OUR job easier.

MANUAL and FOOT OPERATED "SHEAR-SEAL" VALVES



No oilers and filters needed — not critical to dirt and corrosion — made from non-corrosive materials.

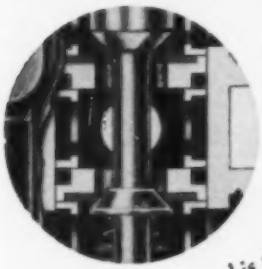
Years of leakproof service — without constant maintenance — Self aligning "Shear-Seal" design compensates for normal wear.

compare this with conventional SPOOL or PLATE VALVES

Alignment is critical — dirt and corrosion cause sticking.

There is no compensation for normal wear — leakage increases with use.

SOLENOID-PILOT CRESCENT® (Self-aligning poppet) VALVES



Quick response (12 milliseconds) due to short travel of poppets and solenoid.

Tight sealing — self-aligning, self-scavenging design adjusts to normal wear — not critical to dirt and corrosion—non-corrosive materials throughout.

No coil burnout — heat dissipating "integral" design.

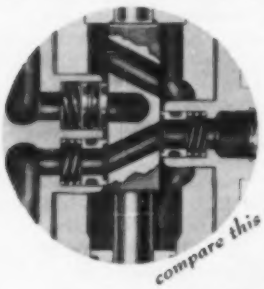
compare this with conventional SPOOL VALVES

Slower response due to long spool travel.

Leakage increases with use—dirt and corrosion particles are ground-in between spool and seals—Sticking!

Overheating causes coil burnout — poor heat transfer of "unitized" design.

DIRECT-SOLENOID OPERATED "SHEAR-SEAL" VALVES



Leakproof for years of service — self-adjusting to wear.

No coil burnout — because valve does not freeze up.

compare this with conventional SPOOL VALVES

Dirt enters spool clearances — develops leaks — causes sticking — sticky valves are to blame for most solenoid burnout.

Write for Air Valve Catalog 9-AV

CONTROL VALVE DIVISION

Barksdale valves

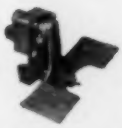
5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

MANUALLY OPERATED

4-Way valves ⅛ to 1½" N.P.T. with or without spring return

Shut-off valves ⅛ to 1" N.P.T. with or without spring return

FOOT OPERATED

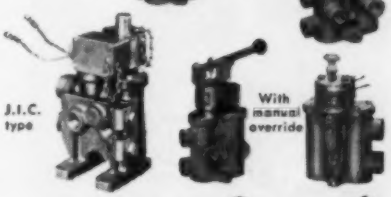


4-Way valves ¼, ⅜ and ½" N.P.T. with or without spring return

SOLENOID-PILOT

4-Way valves ⅛ to ¾" N.P.T. A.C. and D.C. Standard

Explosion-proof



J.I.C. type

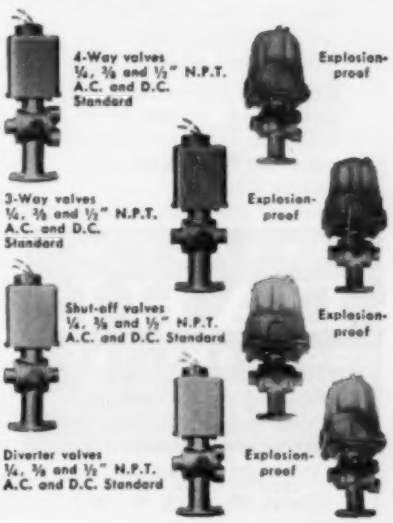
With manual override

3-Way valves ⅛ to ¾" N.P.T. A.C. and D.C. Standard

With manual override

Explosion-proof

DIRECT SOLENOID



4-Way valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

3-Way valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

Shut-off valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

Diverter valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

Here's a complete ½" In-Line Valve with a 7.5 C_v! Springless (pneumatic or hydraulic), spring-to-open or spring-to-close operation. The operating method can be changed easily in the field without extra parts.

Write or call today for complete details on this extraordinarily compact In-Line Valve for on-off or control applications.

OTHER SIZES AND END CONNECTIONS AVAILABLE

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DAHL
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86 TUPELO STREET
BRISTOL, RHODE ISLAND
CLifford 3-9500

VALVES AND CONTROLS FOR THE COMMUNICATIONS, PROCESS AIRCRAFT AND MARINE INDUSTRIES

Circle **44** on Time-Saver Card

NEW PRODUCTS

Continued from page 58

TEMPERATURE CONTROL . . . with bleed pilot valve

Designation: Model OA

Features: Used as controller or high temperature limit. Supply pressure

to 50 psi. Tube assembly has inner tube with higher coefficient of linear expansion than outer tube. As temperature increases, smaller expansion of inner tube lets spring move lever toward valve. Choice of mounting fittings. Temperatures from sub-zero to 2000 F.

Burling Instrument Co.
Chatham, N. J.

Circle **311** on Time-Saver Card

GEAR PUMPS . . . are pressure-balanced

Designation: Models PM-106, PM-110.

Features: Automatic adjustment of wear plates. Can be used as high-efficiency motor without modifica-

tion or adjustment. No high pressure bind. May be driven clockwise or counterclockwise.

Specifications: At 2000 rpm, 1500 psi, PM-106 rated at 13 gpm, PM-110, 20 gpm.

Be-Ge Mfg. Co.
Gilroy, Calif.

Circle **312** on Time-Saver Card

FLOW CONTROL DEVICE . . . for minute flow

Features: Functions without springs, diaphragms, or other mechanical means. Pre-sets for fractions of a cc per minute, regardless of pressure. Can be disassembled, cleaned, reassembled without changing flow characteristics. Has elongated, groove-like orifice. Developed as leakage gauge for small flow rates. Used as fixed or adjustable flow control or as calibration device for test equipment.

Acme Industrial Co.
Chicago, Ill.

Circle **313** on Time-Saver Card

PRESSURE GAGES . . . are accurate within ±¼ of 1%

Designation: Master-Test

Features: Individually dead-weight tested. Accurate within ¼ of 1% plus or minus of maximum dial

reading over entire range. Cover all standard pressure ranges. Compound and vacuum types. Dials have major markings on inner arc, fine graduations on outer arc. Three methods of reading facilitate further accuracy. Using "Twin-tip" pointer, tips are aligned so that they appear as one. With mirror dial, pointer and its reflection are aligned. With "Non-parallax" dial (shown), clear Plexiglas insert along outer edge of dial optically raises graduations and lines them up at what appears to be same level as pointer. Readings are correct even if taken at an angle.

Specifications: Dial sizes 4½", 6", 8". Wide range of case patterns.

Marsh Instrument Co.
Div. Colorado Oil & Gas Corp.
Skokie, Ill.

Circle **314** on Time-Saver Card

Continued on page 136

AEROQUIP CAN ASSIST YOU AT ALL PHASES OF MANUFACTURE

- DESIGN
- PROTOTYPE
- PRODUCTION
- FIELD SERVICE
- SERVICE PARTS

You Can Get Specialized Types of Aeroquip Single Wire Braid Hose For Any Application

1503 HOSE
for hydraulics, air, gasoline, crude, fuel and lube oils, hot water systems; for pressures up to 3000 psi., depending on size; temperature range —40° F. to +275° F.; in ¼" to 2½" O.D. tube sizes.

2631 AND 2632 HOSE
for hydraulics, gasoline, crude, fuel and lube oils, air and water systems; abrasion-resistant rubber cover; temperature range —40° F. to +250° F.; for pressures up to 3000 psi., depending on size; in ¼" to 3" O.D. tube sizes.

2802 HOSE OF TEFLON
with patented* ***"super gem"*** Reusable Fittings for heavy-duty steam, chemical, air compressor discharge lines; temperature range —100° F. to +500° F.; for pressures up to 1500 psi. (200 lbs. steam); ¼" to 1¼" O.D. tube sizes.

1532 HOSE
for phosphate-ester base hydraulic systems up to 3000 psi., depending on size; also suitable for anhydrous ammonia applications; temperature range —40° F. to +275° F.; in ¼" to 2" O.D. tube sizes.

2601 LIGHTWEIGHT HOSE
for engine fuel and lube systems; withstands temperatures up to +300° F., vibration and pressures encountered in heavy-duty engine operation. Available in ¼" to 2" O.D. tube sizes.

1533 HOSE
for LP-Gas applications; designed to provide contact points for safe conductivity of static electricity; listed by Underwriters' Laboratories for all engine and fixed installations; in ¼" to 1" O.D. tube sizes.

All Aeroquip Hose Fittings Are Detachable, Reusable

split flange fittings

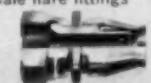
S.A.E., J.I.C. & P.T.T. swivel nut fittings

S.A.E. & J.I.C. male flare fittings

S.A.E. & J.I.C. swivel elbow fittings

male pipe fittings

"super gem" (Teflon) male pipe fittings



"super gem" (Teflon) J.I.C. swivel nut fittings

S.A.E. & J.I.C. swivel nut fittings

Aeroquip

AEROQUIP CORPORATION, JACKSON, MICHIGAN

INDUSTRIAL DIVISION, VAN WERT, OHIO • WESTERN DIVISION, BURBANK, CALIFORNIA
AEROQUIP (CANADA) LTD., TORONTO 19, ONTARIO

AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

"super gem" is an Aeroquip Trademark.
Teflon is DuPont's tradename for its tetrafluoroethylene resin.
*U.S. Patent Nos. 2,833,567 and 2,731,279.

AH-3

Aeroquip Corporation, Jackson, Michigan
Please send me complete information on Aeroquip Single Wire Braid Hose.

Name_____

Title_____

Company_____

Address_____

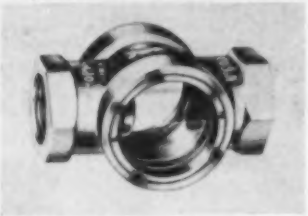
City_____ Zone____ State_____

NEW PRODUCTS

SIGHT GLASS INDICATOR
. . . now in luminum

Designation: Visi-Flow Model No. 640

Features: Indicates direction, viscosity, color, clarity, rate of flow, and purity. For gravity flow. Leakproof inner and outer gaskets of heavy plate glass windows are securely adjusted by threaded flush



retaining rings. Inlet end has threaded tube which directs flow away from windows. Female pipe thread ends.

Specifications: For pressures to 125 psi. Sizes: ½", ¾", 1", 1¼", 1½", 2".

Jordan Corp.
Industrial Sales Div. OPW Corp.
Cincinnati, Ohio

Circle **315** on Time-Saver Card

LIQUID & GAS VALVES
. . . have balanced pistons

Designation: Type A-360 and A-361 Series

Features: Pressure reducing and regulating valves for liquids and gases, except steam. Built-in bleeders optional.

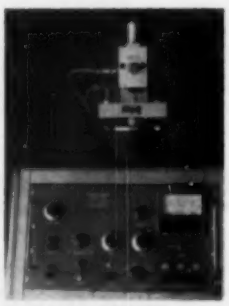
Specifications: A-360 valves have forged brass bodies in ¼", ⅜" sizes. ½" size has all-bronze body. A-361 valves used 3-way or 4-way. All-bronze bodies, in ¼", ⅜", ½" sizes. Both types have spring ranges from 2 to 175 psi. Maximum temperatures to 200 F.

A. W. Cash Valve Mfg. Corp.
Decatur, Ill.

Circle **316** on Time-Saver Card

PNEUMATIC FUNCTION GENERATOR
. . . gives pneumatic signals

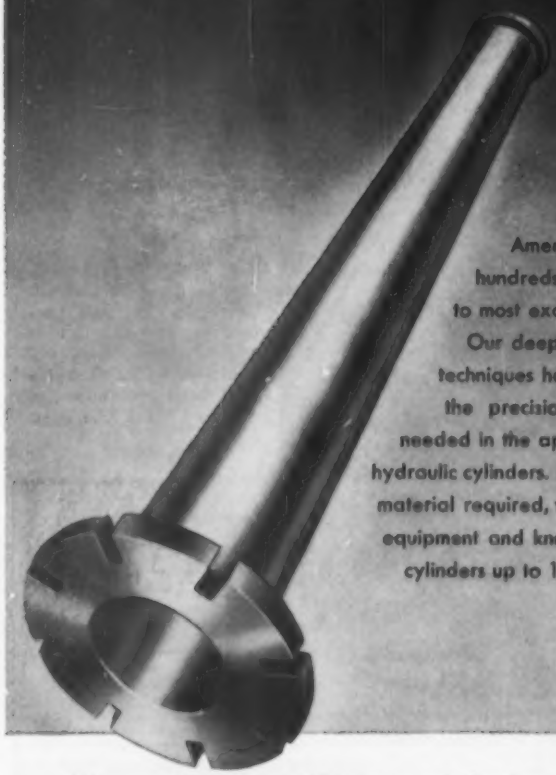
Designation: Functionair Model 100A



Features: For dynamic testing of pneumatic components and systems. Converts electrical signals into

Continued on page 138

AMERICAN
PRECISION BORED & HONED PARTS
TO SPECIFICATIONS



American has produced hundreds of power cylinders to most exacting specifications. Our deep boring and honing techniques have kept pace with the precision internal surfaces needed in the application of air and hydraulic cylinders. Whatever the basic material required, we have the tooling equipment and know-how to produce cylinders up to 16 inches I.D. and to 40 feet lengths.

We are equipped to supply American cylinders bored, honed, flanged, padded and externally machined to your specifications.

AMERICAN HOLLOW BORING CO.

You can depend on American as a reliable source for precision bored and honed parts for your most exacting applications.

1060 West 20th Street • ERIE, PENNA.

Circle **7** on Time-Saver Card

at last...

an *effective one-piece* double-acting seal!

Specially designed for double-acting cylinders—the new "Hallprene" Patent Double-Acting Fluid Seal.

- ✳ Improves sealing
- ✳ Prevents the possible formation of fluid traps
- ✳ Reduces costs
- ✳ Simplifies piston design
- ✳ One seal replaces two

The new "Hallprene" double-acting seal has been developed from the highly successful "Hallprene" Patent Fluid Seal—the most efficient seal for single-acting applications.

HALL & HALL LTD

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P.3887

HYDRAULIC EXPERIENCE:

GEAR PUMPS and FLUID MOTORS

129 hydraulic pump and electric motor combinations are available off-the-shelf, for most applications. Outside this broad range, specific customer requirements can be met by drawing on Eastern's vast design resources.

All standard Eastern gear pumps are low in cost, light in weight, compact and reliable. Unique design features and very close tolerances enable each unit to achieve high volumetric efficiencies.

Check the performance ranges in these three major groups – do they meet your needs?

1200 series – up to 1.6 G.P.M. – pressures to 800 P.S.I.

100 series – up to 5 G.P.M. – pressures to 1500 P.S.I.

700 series – up to 9.8 G.P.M. – pressures to 1500 P.S.I.

In addition to these pumps, Eastern also produces a wide range of fluid motors, each capable of delivering a constant torque over a very wide speed range. They provide up to 14.5 ft. lbs. of torque at 1750 R.P.M. For full information on any one of these pumps, pump-and-motor combinations, or fluid motors, consult the Eastern sales engineer – or write for bulletin 810-N.

Eastern designs and builds

positive displacement pumps • gear pumps • centrifugal pumps

EASTERN INDUSTRIES INCORPORATED
100 SKIFF STREET
HAMDEN 14, CONN.

EASTERN INDUSTRIES PUMP DIVISION

Circle **52** on Time-Saver Card

NEW PRODUCTS

pneumatic pressure signals. Responds to frequencies from 0 to 50 cps when used with volumetric loads to 20 cu. in.

Specifications: Static accuracy, 1% full scale. Operating ranges, 5-1000 psia. Frequency response, dc to 50 cps. Maximum air flow at 50 cps, .03 lb./sec. Power requirements, 117 v ac, 60 cps, 900 watts.

Palisades Engineering Co., Inc.
Pacific Palisades, Calif.

Circle **317** on Time-Saver Card

ADJUSTABLE FLOW CONTROL

. . . has aluminum body

Features: Flow adjustment from near-zero to full in restricted direc-

tion. Full flow at negligible pressure drop in free direction. Stainless steel piston.

Specifications: Female Dryseal pipe sizes: ⅛", ¼", ⅜", ½", ¾".

Ficon Industries
Santa Monica, Calif.

Circle **318** on Time-Saver Card

RESERVOIR FILTER REPLACEMENT ELEMENTS

. . . in 3 sizes, 4 media

Designation: Series 6236

Features: Pleated media for maximum flow rate, contamination ca-

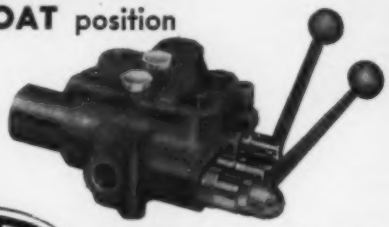
Continued on page 140

Circle **66** on Time-Saver Card

DIRECTIONAL CONTROL

with **FLOAT** position

MODEL WPK



GRESEN HYDRAULICS

NEW 2-spool parallel valve for snow plows, dozers, loaders, graders and similar mobile equipment.

FIRST SPOOL has four (power-neutral-power-FLOAT) positions. It is spring loaded to neutral, but has a detent in the FLOAT position.

SECOND SPOOL is conventional 3-way or 4-way as required, spring loaded to neutral.

BOTH SPOOLS have separate ball checks—are self centering, fully balanced and accurately feathered for fine metering action.

RELIEF VALVE is cartridge type with hardened seat.

TRIPOD MOUNTING feet make installation easy.

CAPACITY—40 GPM at 20 ft./sec.

MAX PRESSURE—1500 psi.

WRITE FOR LITERATURE

GRESEN *Mfg. Co.*

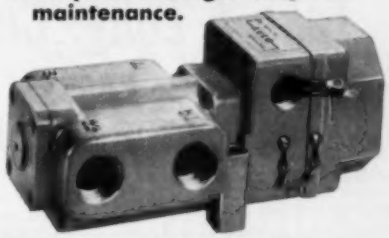
405 35th Ave., N.E., Minneapolis 18, Minn.

Circle **4** on Time-Saver Card

AIR VALVES from stock

A complete range of two, three and four-way valves in sizes ¼", ⅜", ½", ¾".

- High quality—Low cost.
- Compact—Light weight.
- Fast delivery from stock.
- Simplified design—Easy maintenance.



New foot-mounted series available in single or double solenoid models.

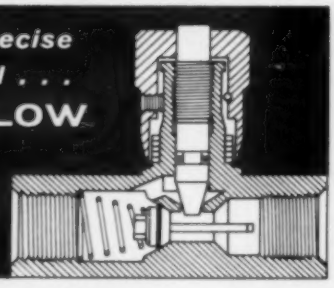
AVCO

AIR VALVES COMPANY

24581 Groesbeck Hwy., Warren, Mich.

For more precise Flow Control . . .

COLORFLOW FLOW CONTROL VALVES



. . . with exclusive color and number calibrated adjustment

- Simple reading, recording, setting and adjusting
- Safe — adjustable under pressure
- Setting can be locked to hold adjustment
- Extremely sensitive — provides high flow and minimum pressure drop

- For oil, gas, vacuum, water and other fluids
- Pressures: Brass to 2000 psi Steel to 5000 psi
- Sizes: ⅛, ¼, ⅜, ½ and ¾" dry seal pipe threads

Write for detailed literature

THE MANATROL Corp.

2372 W. 7th St. • Cleveland 13, O. • CH 1-0575

Circle **99** on Time-Saver Card

TRU-SEAL

TEFLON SEAL

Saves hours in piping installations

PAT. PENDING

Eliminates leaks in oil, air, water, vacuum, chemical lines

Tru-Seal saves hours in assembling piping installations because it enables you to run your pipe lines in any direction you wish, quickly and easily—without having to recut and re-thread piping sections. Wherever used on air, oil, water, steam, vacuum or chemical lines, it seals perfectly at —100° F. to plus 500° F.—*without the use of pipe dope.* Its installation requires only light tightening torque, thus eliminating over-tightening damage to valves, pumps, compressors, and other fittings.

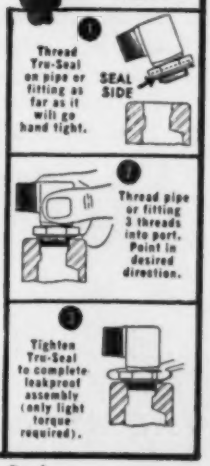
For further information write

TRU-SEAL DIVISION

FLICK-REEDY CORPORATION

7N016 York Rd., Bensenville, Ill.

"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.


1
Thread Tru-Seal on pipe or fitting as far as it will go hand tight.
SEAL SIDE
2
Thread pipe or fitting 3 threads into port. Point in desired direction.
3
Tighten Tru-Seal to complete leakproof assembly (only light torque required).

Circle **147** on Time-Saver Card

NEW PRODUCTS

pacity. Micropleat elements of resin-impregnated cellulose fiber. Pliobond or epoxy bonded to aluminum end caps. Rating is 5-40 microns; temperature range —65 to 275 F. Poromesh elements of sintered wire cloth. Silver soldered to stainless steel end caps (—350 to 350 F), or epoxy bonded to aluminum end caps (—65 to 275 F). Micromesh same as Poromesh, but wire cloth isn't sintered. 5-100 microns. Microbon elements of wound ribbon. Resin-impregnated material Pliobond bonded to aluminum end caps. —65 to 275 F. 40 microns.

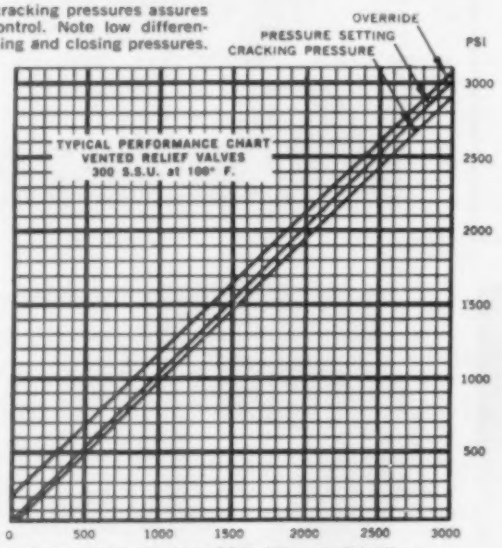
Specifications: OD, 6″; lengths, 2″, 4″, 8″.

Bendix Filter Div.
Bendix Aviation Corp.
Madison Heights, Mich.

Circle **319** on Time-Saver Card

Take A Long, Close Look
AT THE NEW H-P-M RELIEF VALVES

Close control of cracking pressures assures accurate cycle control. Note low differential between opening and closing pressures.



The performance chart tells the complete story: Close control of cracking pressures; choice of high or low venting pressures to match your system requirements; low override for system protection and trouble-free operation. They're interchangeable with industry standards. Available in ⅜″, ¾″ and 1¼″ sizes, subplate mounted, 3000 psi, 0 to 65 gpm.

THE PRICES ARE COMPETITIVE.

⅜″ Relief Valve
3000 psi, 6 gpm

¾″ Relief Valve
3000 psi, 20 gpm

1¼″ Relief Valve
3000 psi, 65 gpm

HPM

H53

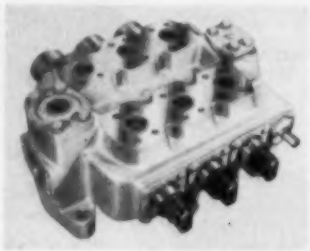
THE HYDRAULIC PRESS MFG. COMPANY
A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

Circle **81** on Time-Saver Card

CONTROL VALVES
. . . 150-gpm nominal capacity

Designation: VDSP7

Features: Directional valves for heavy-duty mobile equipment. Low pressure drop. Open-center, series



parallel circuit. All cylinder ports have integral, individual load check valves. Machined for SAE split-flange port connections. 2-spool and 3-spool (shown) versions.

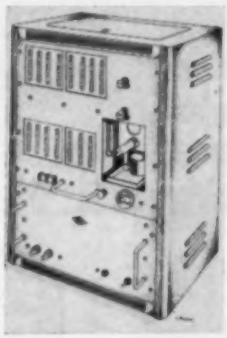
Specifications: Recommended operating pressures to 2000 psi.

Parker Hydraulics Div.
Parker-Hannifin Corp.
Cleveland, Ohio

Circle **320** on Time-Saver Card

PARTICLE COUNTER
. . . is easy to operate

Features: Selects representative fluid sample and counts number of foreign particles in several pre-selected size ranges. Ranges easily



changed. Flushing system cleans. No tramp contamination. Ambient dust conditions don't affect results. Self-calibration system for verification of performance.

High Accuracy Products Corp.
Claremont, Calif.

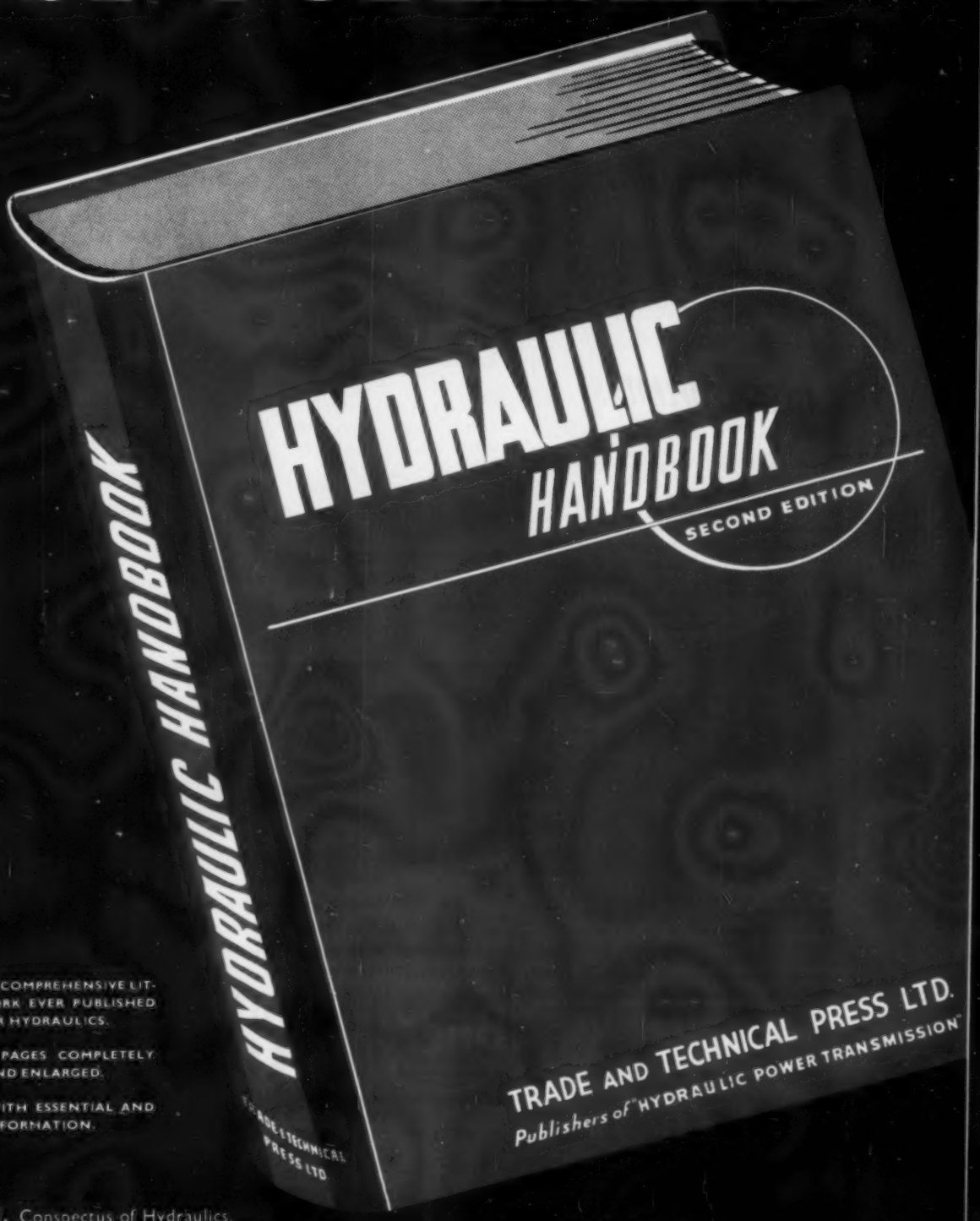
Circle **321** on Time-Saver Card

TIME-DELAY RELAY
. . . has two timing heads

Features: Heads operate from same magnet assembly. Time delay after energization and after de-energization.

Continued on page 142

JUST PUBLISHED!



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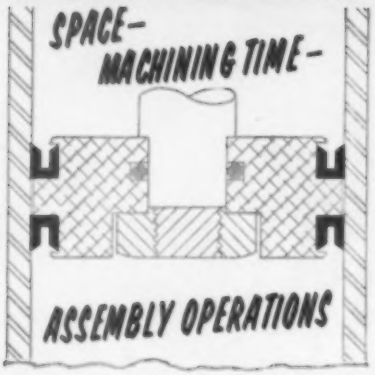
PALMETTO® U-RINGS SAVE...



Now widely used where cup or V-packings were required. Palmetto U-Rings are effecting important savings for designers and builders of hydraulic and pneumatic equipment. Their compactness, versatility, strength and durability permits the use of simple, one-piece pistons . . . eliminates glands, backing plates, and their accessory fittings. Savings in space, machining time, and assembly operations are obvious.

Palmetto U-Rings seal with extremely low friction. There is no opportunity for binding due to over compression. Rugged, rectangular design Palmetto U-Rings (greater height than cross-section width), are more stable than square rings, resist rolling or twisting in piston groove.

Palmetto fabric reinforced U-Rings are available for use where clearances are larger, pressures are higher, or greater strength is required, as in hydraulic service . . . Also available in homogenous rubber for use where clearances are smaller and where pressures are below 500 psi, as in air service. Both styles are designed to snap over a retaining lip and into the packing groove of simple one piece pistons.

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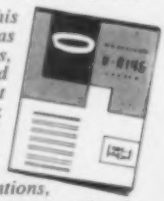

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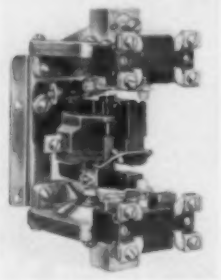
Circle **64** on Time-Saver Card

NEW PRODUCTS

Specifications: Adjustable timing range of .2 sec. to 1 min. Mounting dimensions same as Type DO re-



lays and Types A and H timers. Timer is same width and slightly longer than Type A timer.

Square D Co.
Milwaukee, Wis.

Circle **322** on Time-Saver Card

BOURDON TUBE GAGE . . . has thermal compensator

Features: Thermal growth of linkage members offsets angular position of segment slide, produces pointer error. Opposed angular motion induced by compensator automatically corrects error. Compensator is bimetal bar, part of linkage between moving end of tube and gear segment slide. Ambient temperature change deflects bar. Point at which motion is imparted to slide moves in an arc. This changes slide's angular position and effective length. Gage has external bleeder to evacuate air and gases.

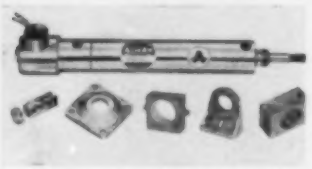
Specifications: Direct readings to 50,000 psi, at 0-100F.

Heise Bourbon Tube Co., Inc.
Newtown, Conn.

Circle **323** on Time-Saver Card

AIR CYLINDERS . . . have integral valve

Designation: Models AVSA, AVSR



Features: Rod of Model AVSA stays out as current maintained

Continued on page 144

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Rivett reducing valves
Just released
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New authoritative instruction manual describes pressure controlled hydraulic valves—information never before published!

You will find this complete and factual material extremely valuable for planning a modern hydraulic circuit! Written by engineers long experienced in fluid power design, this new 8½ x 11 book shows operations and applications of all pressure controlled valves — relief, sequence, reducing, unloading and counterbalance.

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through 3-way, single-solenoid valve. Valve mounted to rear head. No internal provisions for return. ⅛" NPT port in front head for air return, or valve to control rod's outward speed. Model AVSR has return spring. Spacer tube in cylinder's front end prevents complete compression of spring. Brass heads, stainless steel rods. Cylinder tubes resist corrosion.

Specifications: AVSA strokes to 80"; AVSR, to 10".

Allenair Corp.
Mineola, N. Y.

Circle **324** on Time-Saver Card

½", IN-LINE VALVE . . . has high flow coefficient

Features: Valve is ported on both sides of operating piston. Can be assembled for spring-to-open or spring-to-close. Reverses in field without extra parts. Springs available to suit conditions. Valve can operate without spring, as double-acting piston. Bronze sleeve and bridge. Stainless steel plug. Neoprene O-rings. Viton O-rings for corrosive and high-temperature applications. Teflon or other soft seats.

Specifications: Rated for 300 psi at 180 F. 2¾" diameter, 3½" length, including hexagonal, screwed connections. Flow coefficient is 7.5. Cv for normal ½" valves is 4.0.

George W. Dahl Co., Inc.
Bristol, R. I.

Circle **325** on Time-Saver Card

IMPULSE TEST MACHINE . . . for hydraulic components

Designation: Hydrapulse

Features: Pressure gages, hydraulic controls are on front panel. Tem-

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HYDRAULIC FULL FLOW VALVES

Flow Control, Needle, Check, for HYDRAULIC Power

Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.

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A complete line: ⅛", ¼", ⅜", ½", and ¾" female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

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EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

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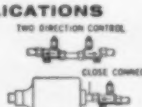
Model KF Knob and Dial Flow Control Valve or Model KN Needle Valve.

Model PF Knob and Dial Flow Control Valve or Model PN Needle Valve. For panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS

Controlling Double Acting Cylinder



Controlling Single Acting Cylinder

AUTOMATION AUTO-PONENTS INC COMPONENTS

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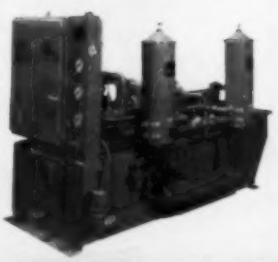

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perature controls on separate console. Oscilloscopes permit tracking of hydraulic impulse patterns. Manifold design for ease of hose installation, precise adjustment of bend radius. Movement of upper and lower manifolds for simultaneous flex, motion, and vibration testing.

Specifications: Provides pressure to 5000 psi, with 7500 psi surges. Temperatures from —100 to 600 F. Liquified CO_2 for cold operation. Impulses sixteen ⅜"-diameter hoses simultaneously.

Resistoflex Corp.
Roseland, N. J.

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PRE-SETTING TOOL . . . for bite-type fittings

Designation: Ferulset, collar type

Features: Pre-sets fitting ferrules onto tubing. Tools have two assemblies: body and nut; seat insert and split collar. Each fitting size has its

seat-and-collar assembly. To use: Clamp tool body in vise. Slip tool nut over tube. Then fitting nut, tool collar and ferrule. When tube with ferrule is inserted in tool body, tool nut is engaged and drawn up to set the ferrule.

Parker Fittings & Hose Div.
Parker-Hannifin Corp.
Cleveland, Ohio

Circle **327** on Time-Saver Card

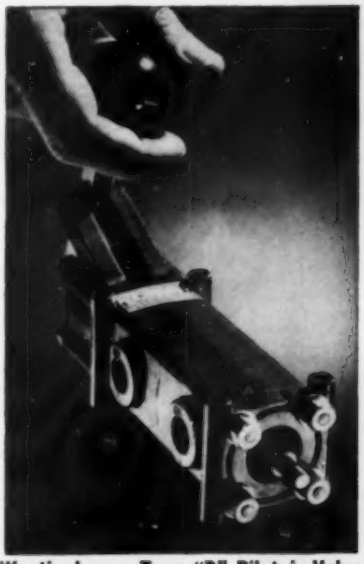
SEPARATOR-DRYER . . . for dewpoint to —20F

Designations: unit—General Dryer desiccant—General Beads

Features: Air goes through revolving baffle. Centrifugal force removes foreign matter, which goes to drainage chamber. Daily drain unit (automatic drain trap recommended). Air goes through inner chamber and stainless diffuser, into disiccant bed. At saturation point, beads dissolve. Beyond saturation

Continued on next page

Typical Control Functions solved by AIR CIRCUITRY



Westinghouse Type "D" Pilotair Valve

Another of Westinghouse Air Brake's many AIR CIRCUITRY components, the "D" PILOTAIR® Valve is a spool-type directional valve that can be operated by a lever, button, cam, solenoid, air pilot, pedal or treadle. Valves available in two, three, and four-way operation, two and three position, open neutral, lap neutral and vented neutral. Port sizes are ¼" and ½" ips. Operators may be on either or both ends. Max. operating pressure: 250 psi.

DESIGN FEATURES. A new design of seal and segment construction gives the "D" PILOTAIR® Valve increased capacity and requires a minimum of maintenance. By rotating operators, their mounting brackets and any of their ports in 90° steps, over one-hundred thousand combinations may be obtained. They operate in any position with air, gas, water and most oils. The "D" PILOTAIR® Valve can satisfy any of your directional valve needs. For more information, ask for catalogue A4-75.01.

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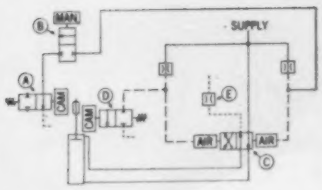
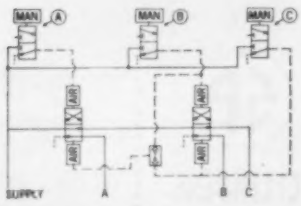
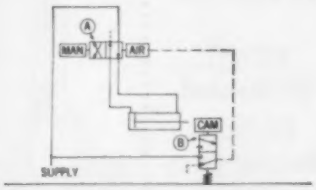


1. AUTOMATIC CYCLING—Supply air flows to the cylinder to extend the cylinder rod and actuate cam operated valve "A." By operating valve "B" air is bled from the right-hand air pilot of valve "C" to operate this device and retract the cylinder rod. This actuates valve "D" and reverses the process. Cycling time may be changed by regulating the FLOREG® valve "E." The stroke is set by moving the cams on the cylinder rod.



2. STATION TRANSFER—Any of the three stations may capture supply air for the station by operating its respective valve. This may be expanded to any number of stations.



3. AUTOMATIC RESET—To reset the operating valve "A" after completion of an operation. Moving the manual operator admits supply air to the cylinder to extend its rod. At the end of the cylinder rod stroke cam operator valve "B" is actuated to connect supply air to the air pilot operator of valve "A." This returns this valve to its original position. Supply air is then connected to the cylinder to retract the cylinder rod. The circuit is now ready for recycling.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor

WESTINGHOUSE AIR BRAKE COMPANY
INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

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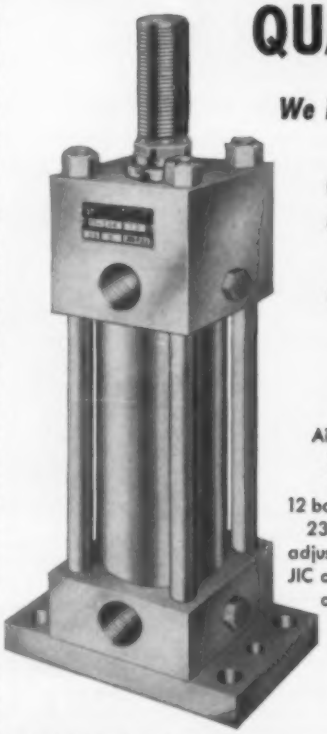
Last Longer

Compact, Fit Anywhere

PROMPT Off-the-shelf DELIVERY Reduces your inventory, saves money

YOU can prove our QUALITY!



We invite you to test our air and hydraulic cylinders against any other! Our confidence is in our quality.

S-P COMPLETE LINE: Air: 200 psi; Hydraulic: 2000 psi (operating), 3000 psi (non-shock); 12 bore sizes—1½" to 14"; 23 mounting types; fully adjustable cushions; 100% JIC and automotive standards; interchangeable.

AA-8668

FREE Engineering Service Representatives in principal cities Phone or Write Today

Find us fast in the "Yellow Pages"

PROVEN QUALITY S-P CYLINDERS • CHUCKS SPEED • PERFORMANCE

THE S-P MANUFACTURING CORP.
30201 Aurora Rd. • Solon, Ohio

A BASSETT COMPANY • IN GREATER CLEVELAND • ESTABLISHED 1916

Non-Rotating and Rotating AIR and HYDRAULIC CYLINDERS • VALVES
POWER CHUCKS • COLLET and DRILL PRESS CHUCKS • ACCESSORIES

Circle **133** on Time-Saver Card

NEW PRODUCTS

point, solution created flows downward. Up-coming air disperses solution into mist. Mist attracts dust which centrifugal force can't remove. With dust's added weight,

mist falls to drainage chamber. Anti-corrosive, anti-toxic beads added about twice a year. No chemical carryover.

Specifications: Entering air must not exceed 110 F. 12 standard models have capacities to 2250 cfm. Working pressures are 150 and 200 psi.

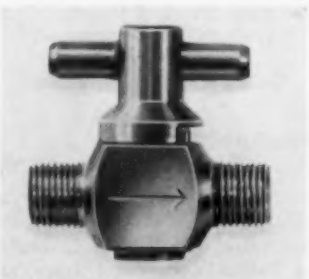
Air Dryer Div.
General Welding & Fabricating Co.
Erie, Pa.

Circle **328** on Time-Saver Card

SHUTOFF VALVE . . . for liquid, gas

Designation: 9500 Series

Features: Repair without removing from line. T-handle color-coded



handle indicates valve position for gas or liquid service. Vacuum or pressure. O-ring on straight plug's cylindrical face prevents leakage past inlet port. Quarter turn from full open to tight close. No spring.

Continued on page 148

Circle **102** on Time-Saver Card

MARSHALLTOWN

THE RIGHT GAUGE FOR YOUR SPECIFIC NEEDS

Available in a wide variety of general purpose and special purpose gauges in pressure ranges to meet your specifications in every particular.

- PRESSURE
- VACUUM
- COMPOUND
- ALTITUDE
- COMBINATION
- DIAPHRAGM
- HYDRAULIC
- AND SPECIAL PURPOSE GAUGES
- DIAL THERMOMETERS (Vapor Tension or Bi-Metal)

WRITE TODAY FOR COMPLETE INFORMATION

MARSHALLTOWN MFG. COMPANY
MARSHALLTOWN 4, IOWA

HYDRONIC REMOTE CONTROL SYSTEM

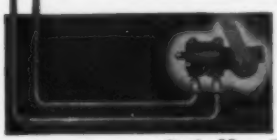
- Completely Hydraulic
- Positive, Accurate
- 100% Responsive

FOR MANUAL MOTION DUPLICATION UP TO 100 FEET AWAY!

The HYDRONIC System is a distinct advance in the remote control field. It offers all the advantages and simplicity of a self-contained hydraulic system. Backlash, motion inaccuracies and installation difficulties inherent in mechanical linkages or push-pulls are eliminated. The HYDRONIC System is unaffected by wear and vibration.

Master and slave maintain perfect synchronization even under wide temperature changes through 114° arc with 500 in. lbs. output in either direction. A simple adjustment permits instant relative positioning between master and slave.

Write for complete information today.



HYDRONIC CORPORATION

12685 Arnold Avenue
Detroit 39, Michigan

Circle **83** on Time-Saver Card

Safe-Q-Lube and Loadless starting

2 good reasons to think about Quincy

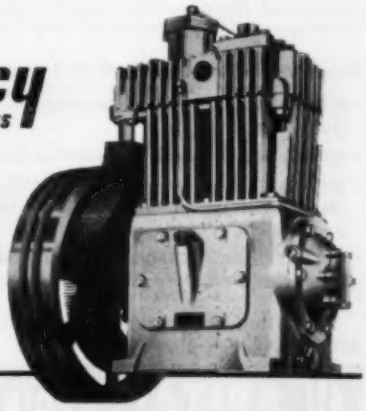
First, there's Quincy's exclusive Safe-Q-Lube pressure lubrication system which automatically unloads the compressor if oil pressure drops. No chance of damage to bearings. Secondly, patented Loadless Starting keeps the compressor unloaded until the motor reaches full speed. Stops are free-rolling, too.

Other Quincy features

- Cushioned Steel Valves
- Timken Bearings
- Lynite Connecting Rods
- Variable Differential Unloader
- Finned Copper Tube Intercooler

Quincy COMPRESSORS

CHECK THE 1960 "Q-LINE" NOW — a complete range of compressor models for all types of industrial applications.



QUINCY COMPRESSOR CO., Quincy, Illinois

Makers of the World's Finest Air Compressors

Circle **125** on Time-Saver Card

NEW PRODUCTS

Can be used for metering. In brass or stainless 303.

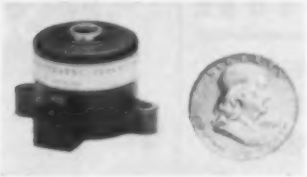
Specifications: Male or female connections in ⅛", ¼" size.

Circle Seal Products
Pasadena, Calif.

Circle **329** on Time-Saver Card

NYLON AIR CYLINDER
. . . has 1⅛" bore

Designation: Nylon Pancake



Features: Light, corrosion-resistant, has high impact strength. For light duty. Shape makes it useful in limited space.

Specifications: Withstood over 1500 psi. in factory tests. 1:1 line pressure ratio. Stroke range from .010 to ½".

Fabco
Cleveland, Ohio

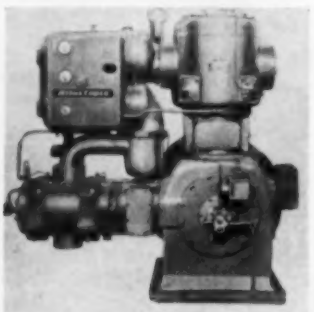
Circle **330** on Time-Saver Card

AIR COMPRESSORS
. . . to 498 cfm at 225 psi

Designation: AR-116, 316, 416

Features: Crosshead shoes absorb lateral stresses. This suits compressors to high-pressure operation. Pistons and cylinders smaller than those of standard units. Two-stage, water-cooled. Delivery is within low temperature range.

Specifications: AR-416 delivers to 570 cfm at 175 psi; to 498 cfm at



225 psi. Speeds are 475 and 410 rpm. AR-316 delivers 382 cfm at 225 psi, 500 rpm; 454 cfm at 175 psi, 585 rpm. AR-116 delivers 222 cfm at 175 psi, 700 rpm; 183 cfm at 225 psi, 600 rpm.

Atlas Copco Eastern
Paramus, N. J.

Circle **331** on Time-Saver Card

HYDRAULIC MOTOR FLOW CONTROL
. . . stops motor runaway

Features: Valve limits flow when it reaches maximum setting. When inlet pressure is reduced to 15 psi,

valve resets, permits normal flow. All stainless steel. Bulkhead fitting on outlet port.

Specifications: Operating pressure is 3000 psi. Normal flow is 2.2 gpm; maximum allowable flow, 3.5 gpm; limited flow, 0.5 gpm.

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

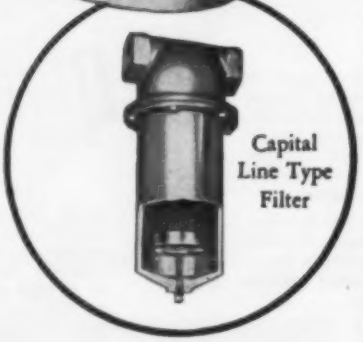
Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- **MONO-BILT 60 Mesh All Stainless Steel (Sump type).**
- **MONO-BILT Standard All Stainless Steel**
- **MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.**
- **LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.**



Capital Line Type Filter

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **29** on Time-Saver Card

Maximum pressure drop across valve is 20 psi for 2.2-gpm flow. Weighs 5 oz.

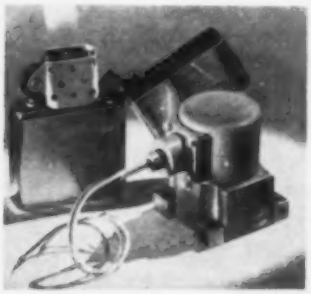
Fluid Regulators Corp.
Painesville, Ohio

Circle **332** on Time-Saver Card

FLOW CONTROL TRANSDUCER
. . . weighs 5 oz.

Designation: Model 25

Features: High stability for high-performance control systems operating within .5 to 1.0 gpm. Spool



position feedback, dry torque motor, parallel magnet design, central filtration. Stainless steel. Liquid determines seal material.

Specifications: Less than 1½" high. Temperatures to 450 F. Operating pressure to 4000 psi. Hysteresis, 3% max.; threshold, .5% max.

Hydraulic Research & Mfg. Co.
Burbank, Calif.

Circle **333** on Time-Saver Card

TUBING VALVES
. . . to 12,000 psi

Designation: AE SpaceSaver

Features: Large port openings, minimum pressure drop. Install by

means of Ermeto-type sleeves. No threading, swaging, flaring, or welding. No special tools.

Specifications: Made of 316 stainless steel. for ⅛", ¼", and ⅜" OD tubing.

Autoclave Engineers, Inc.
Erie, Pa.

Circle **334** on Time-Saver Card

Pathon Series WAL...WHL

AIR AND LOW PRESSURE HYDRAULIC

Cylinders

You can improve the durability and appearance of your equipment with the new Pathon W Series Air and Low Pressure Hydraulic Cylinders.

Valuable space can be saved with these proven screw thread head units. They are available in all standard mounting types plus the type 8, intermediate flange mount (illustrated above) in bore sizes from 1⅛" thru 6".

Specify WAL for air or WHL for oil service to 200 psi. These economical units incorporate non ferrous barrels, hard chrome plated rods, and "U" cup rod packing for minimum friction.

Specify WAT for air service to 250 psi; or WHT for oil service from 350 to 500 psi, depending on bore size. These units incorporate hard chrome plated steel barrels, case hardened, chrome plated rods, and multi-lip rod packing.

All Pathon cylinders have externally replaceable rod packing.

Write for Bulletin #25

Pathon MANUFACTURING COMPANY
3823 PACIFIC AVE. • CINCINNATI 12, OHIO

A-59

FLUID OPERATED AND CONTROL EQUIPMENT

Circle **121** on Time-Saver Card

NO OTHER PRESSURE GAUGE OFFERS SO MUCH

Rugged beyond all mil specs, these light weight Bourdon-Helix gauges maintain constant accuracy under the most severe environments.

Essentially custom-made to individual specifications, Bourdon-Helix designs have been successfully created for over 1800 special applications, any one of which may be a solution to your gauge problem.

Catalog available upon request

Glassco instrument company

777 S. Arroyo Parkway • Pasadena, Calif.

Circle **62** on Time-Saver Card

USEFUL LITERATURE

Continued from page 63

PLASTIC DUST BOOT

Protects reciprocating rods. With plastic film thickness of .008", boot has 13 convolutions in less than ¾". Bellows may be installed without increased length or space. With transparent or translucent bellows, trapped oil leakage is apparent. End connections permit breathing, but boot may be fully sealed. Porous plastic boots are self-sealing. In vinyl, vinyl-coated, nylon fabric, and polyethylene film. *A. F. Gagne, Associates, Binghamton, N. Y.*

Circle **415** on Time-Saver Card

DRYERS

For air, gases, and liquids in industrial, processing, and laboratory installations. Units have charges of solid adsorbent. Moisture adsorbed until charge approaches saturation. Reactivation then removes water. For continuous drying, alternate adsorbers used. Reactivation by entering gas, air or gas from blower, or gas from external source. Operate on 4-hour and 8-hour cycles. Handle gas to 2000 scfm, saturation temperatures to 120 F, and pressures from 30 to 150 psig. Manual, semi-automatic, or automatic operation. Graph of water content vs. saturation temperature, at various pressures. Selection chart. Bulletin 160-1. *J. C. Pritchard & Co. of California, Kansas City, Mo.*

Circle **416** on Time-Saver Card

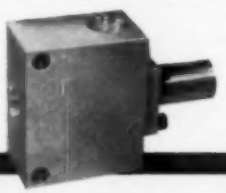
HIGH-PRESSURE HYDRAULIC PUMP

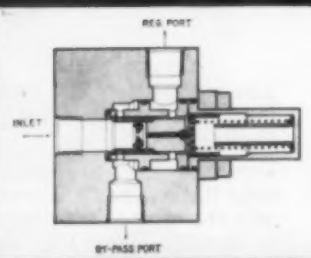
Axial piston pump may be used as motor. Delivers 3.73 gpm at 5000 psi, 3600 rpm. Nominal working pressure: peak, 5000 psi; continuous, 4000 psi. Nominal speed when used as motor: peak, 8000 rpm; continuous, 5000 rpm. Operating temperature from —40 to 200 F. Weighs 7 lb. Data sheet has installation details, table of operating characteristics, performance curves. *Lucas-Rotax Ltd., Toronto, Ontario, Canada.*

Circle **417** on Time-Saver Card

Continued on page 152

Provides Additional Circuits With One Pump



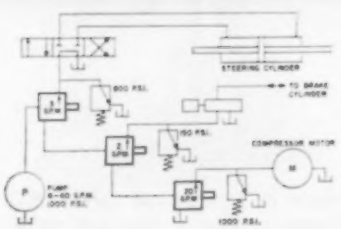


FLOW REGULATOR
(By-Pass & Restrictor Type)

- Constant primary flow regardless of pressures
- By-Pass flow useable at pressures independent of primary pressure

- Sizes — ¼" to 1" Pipe (NPTF)
- Input flow to 60 gpm
- Primary flow ½ to 40 gpm
- For oil to 3000 psi

Write for detailed literature



Fluid Controls, inc.

Member of National Fluid Power Association

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

Circle **56** on Time-Saver Card

Circle **152** on Time-Saver Card

COMPRESSED AIR DRYERS

Stop Freezing of Air Lines Inside and Outside Entire Plant — Extract Moisture and Foreign Particles — Protect Pneumatic Equipment against Corrosion and operate for

LESS THAN 1-CENT PER 16,000 CU. FT.

PATS. PEND.

Van-Air® DRYER

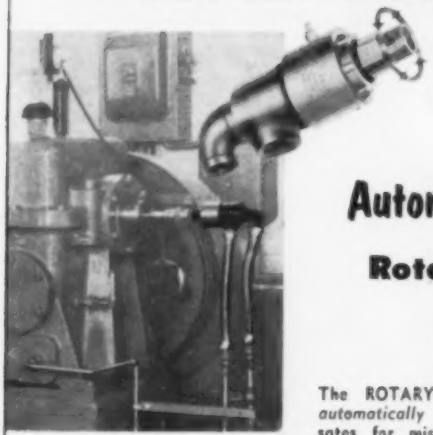
VAN-AIR DRYERS require NO regeneration, heat, power, injection or volume loss — operate automatically — deliver air dry, clean, sterile, non-toxic. Built in sizes to treat any volume of compressor output — large or small — NO LIMIT.

PLANT ENGINEERS — Look into the DOLLAR economy and PENNY cost of VAN-conditioned compressed air. Ask for 16-page brochure with charts.

VAN PRODUCTS CO. ★ Engineers ★ Manufacturers

5713 SWANVILLE ROAD, ERIE, PENNSYLVANIA

The ROTARY UNION*



The Automatic Rotating Seal

The ROTARY UNION *automatically* compensates for misalignment and wear, and *automatically* adjusts to variations in line pressure. Because it maintains its precision mechanical seal at all times, it outperforms and outlasts all similar equipment, and saves you money.

Over 40 standard types and sizes of ROTARY UNIONS cover almost every application where rotating equipment must be heated or cooled. Pipe sizes ¼" through 5".

Write for Bulletin 700X

*Trade Name - Patented

"WHERE *Good Connections* COUNT"®

PERFECTING SERVICE COMPANY, 332 Atando Ave., Charlotte, N.C.

Baltimore — Buffalo — Camden, N. J. — Chicago — Cleveland — Los Angeles
New York — Providence — Montreal — Toronto

Circle **122** on Time-Saver Card

BRUNNER SINCE 1906

syn-on-y-mous with dependable air supply

Where dependable compressed air supply is a "must" there's likely to be a Brunner air compressor.

Installation after installation proves Brunner air compressors . . .

1. Are outstandingly dependable
2. Offer single or 2 stage equipment in all sizes
3. Supply complete air or water cooled aftercooler assemblies with all fittings from one dependable source for all compressor sizes
4. Provide "entire system" duplex units that are "operation readied" to connect to piping and wiring facilities
5. And the air conditioning and heating experience of Dunham-Bush engineers enables them to professionally assist in layout for dependable control systems.

also **WATER COOLED AFTER COOLERS AND OTHER ACCESSORIES BY heat-x A DUNHAM-BUSH SUBSIDIARY**

REQUEST:

- *Bulletin #763 for water cooled specifications*
- *Catalog #36A for ½ through 20 H.P. data*
- *Catalog #653A for consolidated listings ¼-50 H.P.*

BRUNNER DIVISION

DUNHAM-BUSH, INC.

DEPT. AH, WEST HARTFORD 10, CONNECTICUT

Circle **28** on Time-Saver Card

Helical Pumping Gears
•
4-Port Design
•
Mechanical Shaft Seals
•
Replaceable Bearings
•
Hardened Shafts
•
Packed Box Construction
•
Cast Alloy Housings

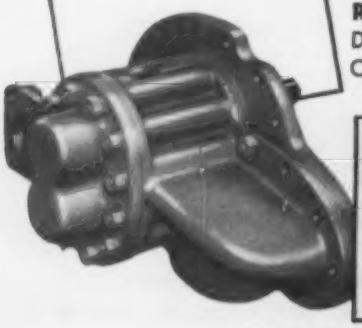
Name your "specs"

Custom Pumps for your design

Consult Roper about the special pumps needed for your projects. Our long experience in designing and building pumps for leading original equipment manufacturers makes possible savings in development time and unit cost.

Whether your problem is high pressure, low pressure, capacity, size or weight — Roper has solved requirements like these for many customers. Let us go to work on the pump for your application. Write or call us today.

ROPER HYDRAULICS, INC.
DEPT. 703 — P.O. BOX 269
COMMERCE, GEORGIA



ROPER
ROTARY PUMPS

Circle **131** on Time-Saver Card

USEFUL LITERATURE

TEFLON RINGS

Bulletin describes application of Teflon GLYD O-rings to hydraulics and pneumatics. Gives data on how rings reduce O-ring friction and chatter, increase systems' pressure sensitivity, and protect and lengthen life of rubber O-rings. Selection charts for ID, OD in sizes comparable to standard O-ring range. Installation drawings. *W. S. Shamban & Co., Culver City, Calif.*

Circle **418** on Time-Saver Card

HOSE, FITTINGS & COUPLINGS

Coverage of each hose, adapter, self-sealing coupling, and fitting includes illustration, part number, dimensions. Bending radius, and working and burst pressures given for six hose types. Cap-plugs, clamps, sleeves, and other products covered. Hose selector chart shows how well four hose types carry over 100 agents. Assembly instructions. Industrial Catalog #204. 38 pages. *Aeroquip Corp., Jackson, Mich.*

Circle **419** on Time-Saver Card

SEALING NUTS

Eliminate leaks on dryseal or standard threads. Need no pipe compound. Replace straight-thread, O-ring boss fittings using original female pipe ports. Positive seal on directional fittings without distortion of mounting bosses. Made of AISI 12L4 steel. Insert is molded virgin Teflon. For pressures to 3000 psi, temperatures from —100 to 500 F. Bulletin 6170. *Weatherhead Co., Ft. Wayne Div., Ft. Wayne, Ind.*

Circle **420** on Time-Saver Card

TUBULAR COMPONENTS & ASSEMBLIES

Fabricated tubing of all commercial metals. Services offered: cut-off, bending, coiling, flaring, beading, swaging, flattening, notching, trimming, drilling, welding, soldering, brazing, assembly. Tubes for hydraulic or pneumatic pressure, fuel, refrigeration or exhaust. Representative items shown. *Coventry Mfg. Co., Inc., North Pelham, N. Y.*

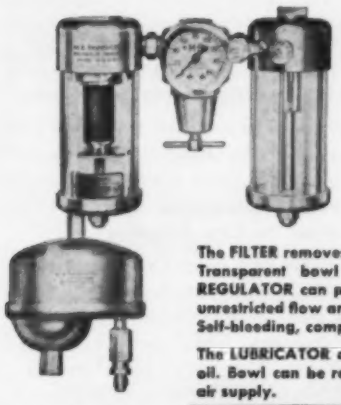
Circle **421** on Time-Saver Card

Circle **97** on Time-Saver Card

GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The **FILTER** removes solids .00039 and larger. Transparent bowl provides visibility. The **REGULATOR** can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The **LUBRICATOR** delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M-B PRODUCTS
46 VICTOR AVE., Div. 12
DETROIT 3, MICHIGAN

---

new ROTORAM® VALVES

WITH EXCLUSIVE ROTATING STEM

for MILLIONS of TROUBLE-FREE ACTUATIONS

Treadle Valve

Knob Valve

- Low silhouette mounting
- 2024 T4 aluminum bar stock
- Rust-resistant
- Full flow air passages
- Piped exhaust ports
- Interchangeable parts
- Anodized finish

Cam Valve

Finger Valve

Pedal Valve

Hand Ball Valve

Rotoram Valves are available in 3 and 4-way models for ⅛", ¼", ⅜" and ½" pipe sizes. Special Block "V" Packing permits free ram movement, insures long valve life. Port entry from either left or right side. Ask your AIR-MITE Distributor, or write for complete details and illustrated catalog.

AIR-MITE DEVICES, INC.
4401 W. Kinzie St., Chicago 24, Ill.

Circle **5** on Time-Saver Card

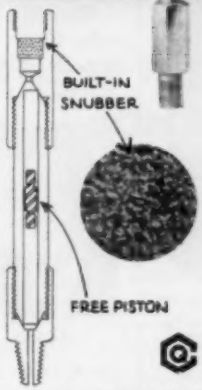
Circle **34** on Time-Saver Card

Chemiquip's

a NEW concept in PRESSURE INSTRUMENT PROTECTION

WORKER SAFETY

FLOW CHECK SNUBBER



Now, a simple, self-contained, low-cost, foolproof method of protecting valuable instruments . . . preventing the escape of noxious, toxic or flammable gases and liquids in the event of rupture in the pressure instrument system.

- Will withstand pressures up to 30,000 psi
- Completely isolates instrument from the pressure transmitting media
- Works equally well with instruments actuated by bourdon tubes or diaphragms

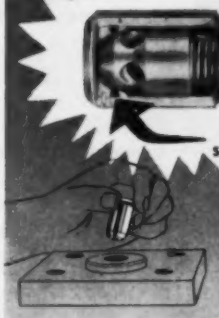
And, Chemiquip's built-in snubber

- Prevents transmission of line surges and pulsations
- Never plugs or clogs

CHEMIQUIP CO.
36 East 10th Street, New York 3
GRamercy 7-3772

For greater plant and/or instrument efficiency, write, wire, phone NOW for detailed Bulletin BW-741.

NEW! KEPNER Kepsel



a cartridge type valve insert

The Check Valve that cuts costs of Design and Installation 75% and more!

- Leak Proof—At All Pressures
- Low Pressure Drop at Full Flow
- Eliminates All Threaded Connections
- Eliminates Expensive Machining

Small in size—big in capacity—simple to install—the KEPNER Kepsel Cartridge Type Check Valve is designed for positive performance. Eliminates expensive machining, finishing of fine, close tolerances, metal surfaces—dirt can't hurt it.

Write for complete technical data

*Patent Applied For

KEPNER PRODUCTS COMPANY
7321 West 59th Street Summit, Illinois

Circle **90** on Time-Saver Card

Separate disc design

GIVES CUSTOM SIZE STRAINERS

at new low cost!

Gals. per Min.	Pipe Diam.	Filter Area Sq. In.
5	¼"	61
8	¼"	92
10	1"	122
20	1¼"	218
30	1½"	311
50	1½"	370
60	2"	385
75	2"	471
85	2½"	514

Whatever type of hydraulic equipment you manufacture—you'll find the unique separate disc design of Ripley Strainers makes possible a wide range of both standard and special sizes to fit your *exact* needs . . . *at low unit cost!*

Maximum filtering area in *any* rated size, plus smooth discs with no crevices to clog or reduce flow—make Ripley Strainers the best buy on the market! Send for complete specifications and price information today!

Gals. per Min.	Pipe Diam.	Filter Area Sq. In.
5	¼"	61
8	¼"	92
10	1"	122
20	1¼"	218

Over 35 years in the manufacture of both screens and strainers.

Ripley SCREEN & STRAINER CO.

Filter Division

32749 Northwestern Highway • Farmington, Michigan

Circle **128** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Adams, Lansky & Lawrence advance at Hannifin

Hannifin Co. Div., Parker-Hannifin Corp., Des Plaines, Ill., has appointed vice-president H. H. Adams to the post of manager of

Adams

Lansky

the power cylinder division. He was formerly vice-president, manufacturing. Z. J. Lansky, now manager of the valve and Crown division, was chief engineer of the power cylinder division. M. E. Lawrence has been named manager of the machinery division.

Aeroquip's Western Div. expands Burbank plant

The Western Division of Aeroquip Corp. recently added 29,500 square feet to its Burbank, California plant. Part of a $2,400,000 expansion program, the addition houses both machine and office areas. The plant area now exceeds 80,000 square feet.

Nielsen Hydraulic promotes Lopez, Obermeyer

Gerald F. Lopez has been elected vice-president and general manager of Nielsen Hydraulic Equipment, Inc., Pelham Manor, N. Y. He joined the firm in 1952, and later managed branches in West Hartford, Conn., and Linden, N. J. John Obermeyer of the New York sales dept. replaces Lopez at Linden. He joined Nielsen in the export dept. and was promoted to sales correspondent, domestic sales.

Greer Hydraulics, Inc. moves to Los Angeles

Early this year, Greer Hydraulics, Inc., will move to Los Angeles its R&D and production facilities in missiles, GSE, and hydraulic systems. The initial plant area is 50,000 sq. ft. The Eastern territory will be covered by a New York sales and service office.

Wilkerson names Gedney

Spencer Gedney has been named service manager of Wilkerson Corp., Englewood, Colorado. He will supervise all service functions, and will integrate all engineering changes into the company's service manual. With Wilkerson for three years, Gedney was a direct factory sales engineer.

Gedney

Heaton

Heaton takes over Iowa territory for Roper

Walter F. Heaton has been appointed district sales manager for rotary pump products of Roper Hydraulics, Inc., Commerce, Ga. He will cover Iowa.

Continued on page 156

Circle **139** on Time-Saver Card

TubeXperience in action

10 important reasons why Superior SAE Hydraulic Steel Tubing is your best buy

- **Ease in bending and flaring,** with no loss of ductility in storage or service, through use of 0.12% max. carbon content nonaging steel
- **Consistently uniform tubing** through careful inspection of raw material and tubing in process
- **Bright scalefree OD and ID** through controlled atmosphere annealing
- **Smooth ID** by mandrel drawing close to finish size
- **Assured cleanliness** by hot solvent degreasing before all process anneals and shipment
- **Flare-inspected quality** based on 35% increase of OD
- **100% hydrostatic testing** to recommended working pressures
- **Rust preventive treatment** of all tubing before shipment
- **All tubing boxed and wrapped** for cleanliness and to protect against bending and denting during shipment or in warehouse storage
- **A complete range of sizes** stocked and sold by leading steel service centers

FREE! Bulletin 39 which contains bending data, working and bursting pressures, and flow information. Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

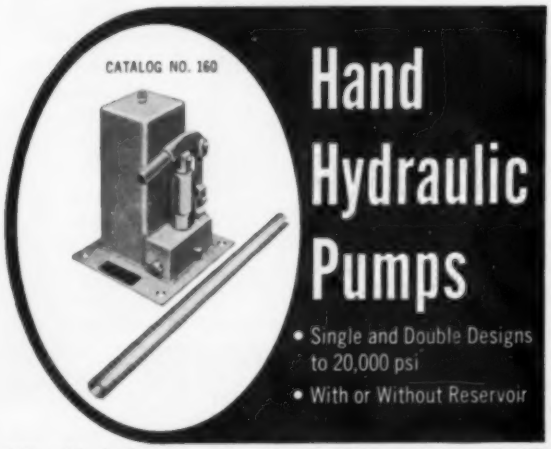
Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010 in. to ⅞ in. OD—certain analyses in light walls up to 2½ in. OD

West Coast: Pacific Tube Co., Los Angeles, Calif. • FIRST STEEL TUBE MILL IN THE WEST



160 cubic inch reservoir with 8"x 8" base plate and 18" long handle.

Available with optional size pistons ⅜", ½", ¾", 1" and 1½".

We specialize in the manufacture of hand pump units which operate in temperatures from −65° F. to +160° F. and with any capacity reservoirs required. Pumps can be furnished on special order with custom seals to handle various aircraft types of fuels such as Pydraul, Skydrol, Oronite, etc.

The single pump with ½", ¾", 1" or 1½" piston is now available in stainless steel.

for additional information write:

WILLIAM S. PINE

hydraulic hand pumps for 1001 uses

1635 East 22nd St., Los Angeles 11, Calif.

Circle **124** on Time-Saver Card

PULLS UP TO 28" OF VACUUM ...CONTINUOUSLY!

no messy, oil-laden discharge vapors

B&G Vacuum Pumps are *oil-less* units that will pull up to a 28" vacuum—not intermittently but *continuously!*

These pumps are constructed with carbon-graphite piston rings and skirts—bearings are grease packed and *lubricated for life.* This oil-less operation not only means freedom from expensive maintenance and lubrication problems but does away with messy, oil-laden discharge vapors.

B&G Vacuum Pumps are extremely compact—can be easily integrated with equipment and machinery designs. Available as bare dry Vacuum Pumps or dry motor Vacuum Pumps, powered by B&G-built, quiet, vibration-free motors, displacements to 6.57 CFM at 1725 RPM. Write for Bulletin GO-259.

Two B&G Vacuum Pumps are integral components of this vacuum lifter which handles 2,000 lb. metal sheets.

FULL LINE OF OIL-LESS AIR COMPRESSORS

Quiet, smooth-running, long-lived B&G Compressors deliver clean, cool, dry, oil-free air. 58 models—from portable, lightweight 35 lb. single stage to 175 lb. two stage motor compressor units—bare compressors—tankless and air tank motor compressor outfits—A.S.M.E. or non-code tanks.

B&G

Oil-less VACUUM PUMPS

BELL & GOSSETT COMPANY

Dept. GC-66, Morton Grove, Illinois

Circle **21** on Time-Saver Card

NOW! POSITIVE LOCKING WITHOUT
THE LIMITATIONS OF WIRING DEVICES

NEW STRATOLOK
REG. APPLIED FOR

SELF-LOCKING FLUID COUPLING NUT

Eliminate time and expense involved in safety wiring. The new Stratolok* self-locking fluid coupling nut assures positive locking and trouble-free sealed joints in critical applications.

Stratoflex's new Stratolok series of self-locking nuts is based on a 3-way mechanical displacement of threads. The Stratolok locking element permits free hand starting and insures that the lock is fully engaged before the nut is completely seated. When fully seated, the lock is retained.

Stratolok nuts meet all locking performance requirements of Specification MIL-N-25027. They are available in a complete range of sizes and are reusable and completely interchangeable with existing AN and MS nuts. Stratolok "S" series nuts, for temperatures up to 550°F, are Cadmium-plated steel; "CR" Series, for temperatures up to 800°F, are silver-plated stainless steel. For complete information, write for Stratolok Bulletin S-8.

*Formerly SPS Self-Locking Nut

SF5-0

STRATOFLEX Inc.

P.O. Box 10398 Fort Worth, Texas
Branch Plants: Hawthorne, Cal., Fort Wayne, Toronto
In Canada: Stratoflex of Canada, Inc.

SALES OFFICES:
Atlanta, Chicago
Cleveland, Dayton
Detroit, Fort Wayne
Fort Worth, Hawthorne
Houston, Kansas City
Milwaukee, New York
Philadelphia, Pittsburgh
San Francisco, Seattle
Toronto, Tulsa

Circle 138 on Time-Saver Card

POST SCRIPTS OF INDUSTRY

Neilson named Zeno v-p, engineering & sales

Zeno Hydraulics Corp., formerly Hoen Hydraulic Corp., Salt Lake City, Utah, has named J. G. Neilson vice president, engineering and sales. He has been with the company for several years.

Parker Seal opens new R&D center

Parker Seal Co., Div. Parker-Hannifin Corp., Culver City, Calif., has opened a new R&D center alongside the main headquarters building. The new 20,000-sq. ft. building also houses some administrative offices and special processing.

American Measurement appoints Knapton

Knapton

Kenneth S. Knapton is now marketing manager of American Measurement & Control, Inc., Waltham, Mass. He handles sales and contract administration, advertising and sales promotion of the company's systems and product lines. Former positions include product manager on electrohydraulic control systems for Sanders Associates, and project sales engineer for Vickers, Inc.

Dowty Group, Canadian subsidiary name directors

Dowty Group Ltd., Cheltenham, Glos., England, has appointed J. C. G. Wegerif to its board of directors. He will advise on the group's production policy. Dowty Mining Ltd., Ajax, Ont., Canada, has appointed Michael Potts and Peter Sharp to its board. Potts will continue as mining manager of Dowty Mining Equipment Ltd., Cheltenham, and will handle liai-

son between the Canadian firm and the parent Dowty Group Ltd. Sharp, as director and general manager, will supervise all company activities in Canada and the United States.

Menig will manage sales of PSP, Induction Motors

Menig

Albert A. Menig will take the new post of assistant sales manager of PSP Engineering Co. and Induction Motors of California. Both Maywood, Calif. companies are divisions of IMC Magnetics Corp., New York. For over five years, Menig has been a sales engineer and technical liaison manager in the field of electromechanical devices.

George Clapp appointed sales manager

George W. Clapp has been promoted to sales manager of United Electric Controls Co., Watertown, Mass. He has been with the firm since 1951, as a sales engineer and account manager.

Crane completes Teflon plant

Crane Packing Co., Morton Grove, Ill., has completed a 20,000—square-foot plant for the processing of basic Teflon shapes, and manufacturing Teflon products. The plant houses a centrally-mounted, 400-square foot cupola for vertical extrusions.

Scans names Foerster senior engineer

Charles E. Foerster, Jr. has been named senior engineer at Scans Associates, Inc., Livonia, Mich., engineers and builders of hydraulic, pneumatic, electrical, and mechanical testing devices. Foerster has worked on automotive and aircraft testing devices for thirteen years.

Continued on next page

A HANDFUL OF POWER

DOWTY Pressure Balanced HYDRAULIC GEAR PUMPS

Pressures to 2500 PSI • Outputs from 1/2-60 GPM

Shown here is our Model GP2-85 which will deliver 18 GPM at pressures to 2000 PSI. Volumetric efficiency exceeds 95% throughout the operating range. Fully pressurized lubrication independent of discharge pressure. 14 other sizes available.

MAIL FOR COMPLETE DATA

Berry Hydraulics
2227 Oliver Building
Pittsburgh 22, Pa.

Name_____

Company_____

Address_____

Berry HYDRAULICS
A DIVISION OF THE OLIVER TYRONE CORPORATION

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HOT AIR anybody can make

but we believe in facts, just plain facts—and for the facts about things hydraulic...write or better yet... call, we'll talk!

UNIVERSAL HYDRAULICS

4500 BEIDLER ROAD
WILLOUGHBY, OHIO
WHITEHALL 2-4595

Circle **149** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

Staihr is Ellis Akin sales manager

Richard J. Staihr is now sales manager of Ellis Akin Engineering Co., Kansas City, Mo. He had sales experience before joining Akin over a year ago.

Wickson to represent Parker Seal

Albert Wickson will represent Parker Seal Co., Div. Parker-Hannifin Corp., Culver City, Calif. He will cover Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.

Union Carbide opens technical center

Union Carbide Chemicals Co., Div. Union Carbide Corp., has opened a technical center on a 400-acre site in South Charleston, W. Va. The center houses activities of 2200 scientists, engineers, and supporting personnel in the R&D and engineering departments of Union Carbide Chemicals Co., the engineering department of Union Carbide Olefins Co., the design and construction department, and the R&D department of Union Carbide Plastics Co.

ON THE JOB...
with CROSS
HYDRAULIC CYLINDERS
Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Cross Engineering Department, today!
■ RUGGED
■ DEPENDABLE
■ ECONOMICAL
CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION
Try CROSS CYLINDERS in your operation... low cost, dependable, and trouble free.
Lowest-Priced Engineered Quality Cylinders Available..
trade mark of Quality in Hydraulic Cylinders...
HYDRAULIC CYLINDERS
CROSS MANUFACTURING CO.
LEWIS, KANSAS – PHONE EA 4-5525
WRITE • WIRE • PHONE...TODAY!!
Circle 43 on Time-Saver Card

Racine Hydraulics expands in Racine

Racine Hydraulics & Machinery, Inc. is adding 21,000 sq. ft. to its main plant, and building a two-story, 8000-sq. ft., R&D plant. The new additions will bring the company's total floor area to 200,000 sq. ft.

Keelavite names agents in Johannesburg, South Africa

Keelavite Hydraulics, Ltd., Allesley, Coventry, England, has appointed Holman Brothers, Ltd., Johannesburg, South Africa, as its agent for South Africa and Rhodesia. The Holman company manufactures Keelavite cylinders under license.

Master Pneumatic promotes Edwards to general sales mgr.

Edwards

Master Pneumatic, Inc., Detroit, Michigan, has advanced Robert L. Edwards to the position of general sales manager. He joined the firm in 1950, as a Detroit area salesman. For the past five years, he was regional sales manager for the Midwest and Canada.

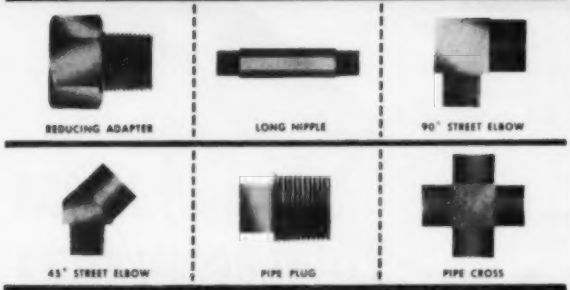
Oilgear's Servocontrol Div. moves to new plant

Servocontrol Division, Oilgear Co., has moved to a new plant at 160 Bear Rd., Waltham, Mass. The plant houses an electronics laboratory, a hydraulics laboratory, a machine shop, a model

Continued on page 160

Circle **54** on Time-Saver Card

FLODAR drymatic seal High Pressure Steel Pipe Fittings



Available from stock — up to 2" size

Bar Stock — for high pressure (2,000, 3,000 & 6,000 psi).

Cost Less — machined from high quality steel, they require less material, cost less than forged high pressure fittings.

Dry Seal Pipe Threads — exclusive Drymatic seal process for cutting female (J.I.C.) threads eliminates wavy threads and tool marks. All FLODAR pipe fittings have (J.I.C.) dry seal threads to minimize leakage.

Immediate Delivery — from stock in 14 styles and sizes from ⅛" to 2".

Also Available In Stainless Steel.

Write for catalog — No. 556A. It covers both tube and pipe specifications.

FLODAR Corp.

16911 ST. CLAIR AVE. • CLEVELAND 10, OHIO

Helicoid Gages give *Sustained Accuracy*, even on the toughest jobs

★ Exclusive Helicoid movement has no gears, no teeth. Shock-proof construction protects accuracy through millions of cycles.

★ Bourdon tubes available in four materials—bronze, steel, stainless steel, and K Monel—won't stretch, crack, or leak.

★ Six cases, including new solid-front safety case, meet every mounting requirement.

★ External pointer adjustment can't be jarred out of position.

★ A complete selection of gages and accessories for hydraulic, chemical, and other service.

Write for Catalog DH-65.

HELICOID GAGES

Helicoid Gage Division

American Chain & Cable Company, Inc.

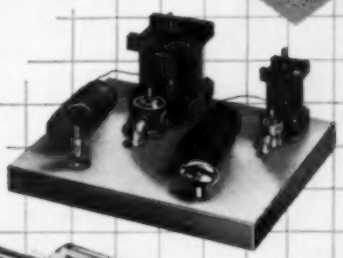
929-H Connecticut Avenue • Bridgeport 2, Conn.

Distributed in Canada by Upton, Bradeen & James, Ltd.
Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Edmonton, Vancouver

Circle **74** on Time-Saver Card

DESIGN PROBLEMS SOLVED by Humphrey "Quick-Dump" VALVES in these...

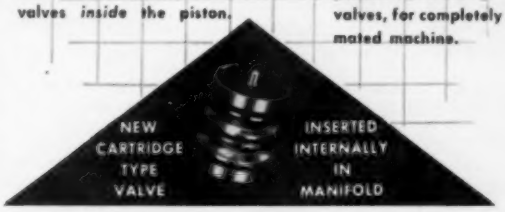
Completely NEW Types of Pneumatic Controls



⅛" valves inserted in special hand controls, to valve air signals for instantaneous operation of piloted valves in remote locations.

Double action cylinder with all manually operated valves *inside* the piston.

10-valve manifold using piloted ¼" and ⅛" insert valves, for completely automated machine.



The remarkable versatility of Humphrey "Quick-Dump" valves has pushed back the horizons for design engineers in the pneumatic control field.

You can get "Quick-Dump" valves with round bodies; with square bodies for mounting on manifold; or in new cartridge type for **inserting internally** in manifold. You can have ⅛" Minivalves that deliver 30.45 cfm, ¼" delivering 80.04 cfm, and ½" delivering 276 cfm at 100 psi. 2-way, 3-way, 4-way types, operated manually, electrically, or by pilot. All valve air, oil, water, other liquids and gases to 125 psi, as well as vacuum. All have built-in quick exhaust and lightning fast cycling speed.

Consult Humphrey engineers about your requirements in pneumatic controls. They will gladly work with you, or design and produce your special control devices for you.

Humphrey PRODUCTS DIV.

General Gas Light Co. Kalamazoo, Michigan

Complete Line of Standard "Quick-Dumps"

Specialists in Pneumatic Devices

Circle **77** on Time-Saver Card

Portable Hydraulic Power Pumps
10,000 psi intermittent
6,000 psi continuous

No. 797-E-SA

No. 797 series
213 cu in. per min. at 10,000 psi

Extra-high-speed drive at high pressure. Applies to a wide range of hydraulic systems. Compact unit . . . pump reservoir, and control valve in one housing. Simply operated, 2-position control handle with advance and return positions. Available with 4-way valve for double-acting rams. Delivers 213 cu in. of oil per min at 10,000 psi with 3 hp a-c motor . . . 106 cu in. with 2 hp motor.

No. 797-G-SA is same pump powered with 4½ hp 4-cycle, air-cooled gasoline engine.

No. 798 series
28 cu in. per min.
. . . at 10,000 psi

Easily carried, high-pressure pump. Has exclusive fast approach . . . high volume, low pressure . . . automatic change-over to low-volume, high-pressure drive. Develops 6,000 psi continuous pressure, 10,000 psi intermittent. Choice of integral 2-way or 4-way valve. Built-in 115 - 230 V ¾ hp a-c motor. Also available with built-in 1.7 hp gasoline engine, universal or low-voltage motor. Write for illustrated data sheets.

ALSO A SELECTION OF HYDRAULIC HAND PUMPS AND VALVES

GREENLEE TOOL CO.
1775 Columbia Avenue
Rockford, Illinois

GREENLEE

Circle **45** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

shop, and a drafting area. Complete electrohydraulic systems can be designed, built, and tested in the plant.

Van Aken to cover southern Illinois for Hydreco

Harry Van Aken has taken a sales engineering post with Hydreco Division, The New York Air Brake Co., Kalamazoo, Mich. Covering southern Illinois, he works out of Peoria.

Van Aken

Oosten

Bell & Gossett names Oosten vice-president, engineering

Louis S. Oosten has been named vice-president, engineering, of Bell & Gossett Co., Morton Grove, Illinois. Oosten joined the firm in 1934, as a machine operator. In 1935, he joined the engineering staff. From 1943 to 1953, was assistant to the chief engineer and, in 1953, was promoted to plant superintendent.

Resistoflex establishes office in Mobile

Resistoflex Corp., Roseland, N. J., has established a district office in Mobile, Alabama. Charles M. Parker heads the office. He is technical representative for the Gulf Coast military installations.

Parker-Hannifin reassigns industrial sales engineers

Parker-Hannifin Corp., Cleveland, Ohio, recently made four changes in its field organization. D. G. Henderson, sales engineer

Continued on page 162

for longer life and no oil leakage
specify NARDA Piston Accumulators

FEATURING:

- Self-balancing piston
- Triple "O" ring seal—all three active
- Auto-relieving piston
- End caps provide dashpot action and use same seals as piston, thus requiring only one seal size for spare parts.

FOR:

- Auxiliary power
- Surge dampener
- Emergency power
- Leakage compensator
- Pressure transfer barrier

THREE MOST POPULAR SIZES:

One quart, one-half gallon and one gallon, 13", 18⅛" and 28½" long, respectively. All 4¼" diameter. (Larger sizes: 2½, 5, 10 gallons; all 8⅝" diameter.)

Standard temperature range:—40° to +220° F. Seals also available for fuels and special fluids as well as for temperatures from —65° to 400° F.

For more information about these new Narda Accumulators, as well as other models now in development, write to us at Dept. AHP-2.

Some distributorships in Western and Southern states still open.

the narda hydraulics corporation
122 HERRICKS ROAD, MINEOLA, N. Y.
Subsidiary of The Narda Microwave Corp.

Circle **110** on Time-Saver Card

Circle **136** on Time-Saver Card

THE CYLINDER for jigs, fixtures and automation!

SHEFFER **Valv-N-Hed**®

CLA-SV SERIES

INTEGRAL SOLENOID VALVE, SPRING RETURN 1⅛ BORE CLAMP TYPE CYLINDER

For air, oil or water operation. May be face, front flange, or horizontally mounted. Stock strokes 1", 2" and 3". Other strokes and double acting type available. All materials corrosion-resistant. Employs time tested and proved SHEFFER CLA SERIES cylinder. Ease of operation and extreme compactness makes it ideal for automation, jigs, and fixtures.

LIST PRICE from distributor or factory STOCK:

$19.95

Write for Bulletin No. 455

THE SHEFFER CORPORATION

NFPA FLUID POWER

SOLD BY LEADING DISTRIBUTORS NATIONALLY

Cincinnati 15, Ohio
Phone VA-lley 1-0320

SEE PHONE BOOK YELLOW PAGES

2568

REMOVE MOISTURE from

COMPRESSED AIR LINES

Air operated tools, instruments and controls demand air that is

COOL CLEAN & DRY

and the

MURPHY AFTERCOOLER SYSTEM

GUARANTEES IT!

Write now for **FREE** Data Sheet No. 2568.

JAMCO

JAS. A. MURPHY & CO., INC.

1417 EAST HIGH STREET, HAMILTON, OHIO

Circle **109** on Time-Saver Card

HOKE

Flow Sheet

HOKE REPORTS ON FLUID CONTROL (1)

HOKE'S NEW PLASTIC STEM TIPS END CHRONIC FAILURE PROBLEM

Galling and scoring valve seats plagued valve users and manufacturers for years, until somebody thought of using plastic stem points. This idea worked well at low pressures, but when the pressure increased – poof! – the valve blew its tip. Up to now, this problem had continued to bother valve makers.

Fortunately, a die-hard Hoke engineer insisted he could put a permanent plastic tip on a high pressure valve. We gave him his head and he gave us a plastic-tipped valve-stem (using either Kel-F or Nylon). His unique design incorporates a crimped metal shell that grabs the plastic tip and *really* holds!

Not satisfied with this monumental accomplishment, he proceeded to tackle leak problems at the stem packing. He put an O-ring seal on the stem and compressed it with a newly-designed Nylon collar. The collar serves a dual role, for it also prevents grit and other foreign matter from chewing up the O-ring. Valves of this new design have performed successfully up to 3500 psi. Our die-hard engineer not only ended galling, but also seat leakage, stem leakage and wear problems – all at one swoop.

There's only one feature about this new development that worries us – since we do not expect replacements we may have designed ourselves right out of the valve business! We make these little dandies of either forged brass, bar stock or 316 Stainless, with ⅛" and ¼" male connections. Temperature limit is 400° F. For the complete story, write, wire, phone or we'll come see you.

WHAT GOES WITH WHAT?

This is a question engineers and chemists are constantly asking each other. Not that we want to do away with this healthy interplay at the water cooler, but we have put together a slide rule that answers all these questions. It lists 22 metals and materials and their degree of resistance to 247 corrosive agents.

Got yours? Write now while there are a few (thousand) left.

HOKE, INCORPORATED
87 Piermont Road, Cresskill, N. J.

Send me complete information on the Hoke products checked below:
☐ Plastic Stem Tips ☐ FREE Corrosion Slide Rule ☐ Have a salesman call

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

Circle **76** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

in Pittsburgh, is promoted to regional sales manager for Southern California. C. A. Storch, Chicago sales engineer, succeeds Henderson. Roy E. Powers is transferred from Detroit to the southern Ohio territory. Robert O. McCarville is now a Chicago sales engineer.

Fesler is Kobe's western representative

M. H. Fesler has been appointed western industrial sales representative of Kobe, Inc., Huntington Park, Calif.

Hydra Electric Corporation organizes new division

Hydra Electric Corp., Burbank, Calif., has organized a new division, General Kinetics Corp. The division will manufacture electro-hydraulic systems and components. General manager is Gerald Dennis, electronics engineer. Director of engineering is Oscar L. Wadkins, research engineer and designer. Clair F. Siefert is manager of the hydromechanical dept. William T. Browne, Jr., was recently promoted to assistant sales manager of the division. Roger G. Riefler has joined the engineering staff.

Aeroquip promotes Jones, Emery

Aeroquip Corp. has promoted M. Lloyd Jones, Jr. to general manager of the General Logistics Div., Burbank, Calif. He has been with Aeroquip since 1951, recently as manager of distributor sales for the Industrial Div. Victor Emery is general sales manager of the Industrial Div., Jackson Michigan. He was manager of manufacturers' sales for the division. Emery joined the firm in 1949.

S-P assigns O'Reilly and Rogers

S-P Mfg. Corp., Cleveland, Ohio, has assigned sales engineering posts to Thomas A. O'Reilly and George V. Rogers. O'Reilly is

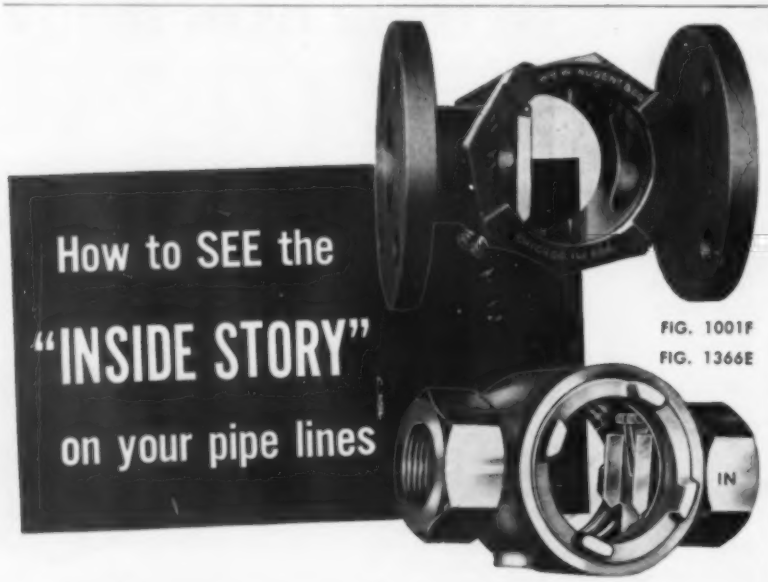
O'Reilly

Rogers

in charge of the Philadelphia district office, which serves southern New Jersey, eastern Pennsylvania, Delaware, and Maryland. Rogers heads the New London, Connecticut, sales office, which serves western Connecticut and Massachusetts.

Minnesota Rubber expands again

For the fourteenth time since 1946, Minnesota Rubber Co., Minneapolis, has expanded. This time, they added 12,000 sq. ft., which will house rubber mixing equipment and twelve electrohydraulic presses. Total manufacturing area is 120,000 sq. ft.



Do you have pipe lines through which constant flow is a critical factor? Could slowdown or stoppage cause untold damage to valuable equipment? If it's important that you know what's going on inside a pipe line . . . Nugent Sight Flow Fittings can be one of the most economical investments you've ever made.

These fittings have large double windows to aid visibility. A spring compensated, hinged, indicator gate moves in proportion to the flow and is visible from either side, even when liquid is dark or discolored. Fittings available with electrical contacts to operate a bell or light should liquid flow cease. Sizes $\frac{3}{8}$" to 6" inclusive . . . in brass, cast iron, and steel. Tapped or flanged.

Complete data upon request.

ESTABLISHED 1907

REPRESENTATIVES IN PRINCIPAL CITIES

WM. W. NUGENT & CO., INC.

3432 CLEVELAND STREET, SKOKIE, ILLINOIS

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

Circle **113** on Time-Saver Card

Valve Controls, Inc. expands in North Hollywood

Valve Controls, Inc., has moved into a new plant at 11120 Cumpston St., North Hollywood, California. Floor area is ten times as great as before.

Chiksan names Powers sales manager

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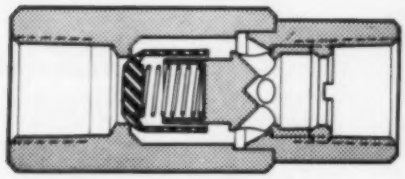
ECONOMICAL
In-Line Relief Valves



- Insures pressure for pilot operated valves
- Limits pressure in lubricating and other low pressure systems
- Large capacity — small size
- Non-adjustable — 15, 45 or 65 psi
- For oil to 3000 psi
- Sizes— 3/8", 1/2", 3/4", 1", 1 1/2", Pipe (NPFT)

Write for detailed literature

Fluid Controls, inc.
Member of National Fluid Power Association

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

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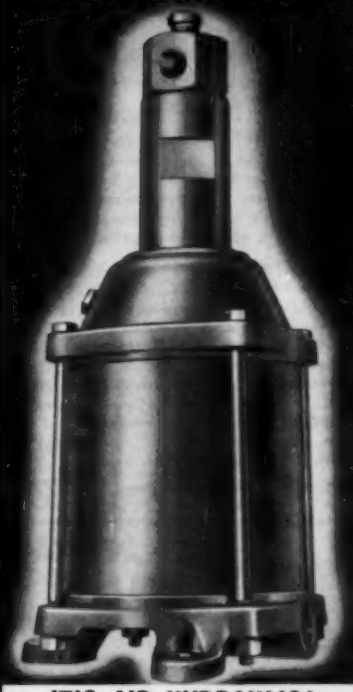

IT'S AIR HYDRAULIC!
Delivers over 3 cu. in. at 3000 psi for less than $100!

It's true! Mass production for our own air-hydraulic products enables us to offer the Wilton high output-pressure booster at half the usual cost! Simple, rugged construction, designed to operate more than a million cycles without maintenance. Easily replaceable seals; wiper cup protecting main seal; anti-friction hydraulic piston; pressed bronze filter in breather hole. Air cylinder and piston are non-ferrous and corrosion proof. Dependable performance proven by thousands of installations. Lower pressures also available. Get the facts about this booster bargain today!*

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*O.E.M. inquiries invited, and will be quoted discount prices. Quotations for unusual requirements submitted on request.

WILTON
TOOL MANUFACTURING CO. INC.
Schiller Park, Ill. AHP-30

Sold by leading distributors the world over!

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POST SCRIPTS OF INDUSTRY

in Pittsburgh, is promoted to regional sales manager for Southern California. C. A. Storch, Chicago sales engineer, succeeds Henderson. Roy E. Powers is transferred from Detroit to the southern Ohio territory. Robert O. McCarville is now a Chicago sales engineer.

Fesler is Kobe's western representative

M. H. Fesler has been appointed western industrial sales representative of Kobe, Inc., Huntington Park, Calif.

Hydra Electric Corporation organizes new division

Hydra Electric Corp., Burbank, Calif., has organized a new division, General Kinetics Corp. The division will manufacture electro-hydraulic systems and components. General manager is Gerald Dennis, electronics engineer. Director of engineering is Oscar L. Wadkins, research engineer and designer. Clair F. Siefert is manager of the hydromechanical dept. William T. Browne, Jr., was recently promoted to assistant sales manager of the division. Roger G. Riefler has joined the engineering staff.

Aeroquip promotes Jones, Emery

Aeroquip Corp. has promoted M. Lloyd Jones, Jr. to general manager of the General Logistics Div., Burbank, Calif. He has been with Aeroquip since 1951, recently as manager of distributor sales for the Industrial Div. Victor Emery is general sales manager of the Industrial Div., Jackson Michigan. He was manager of manufacturers' sales for the division. Emery joined the firm in 1949.

S-P assigns O'Reilly and Rogers

S-P Mfg. Corp., Cleveland, Ohio, has assigned sales engineering posts to Thomas A. O'Reilly and George V. Rogers. O'Reilly is

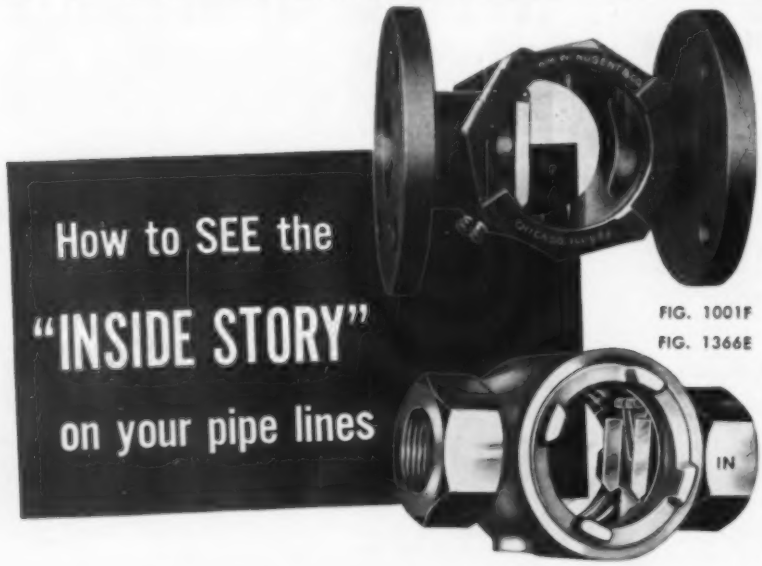
O'Reilly

Rogers

in charge of the Philadelphia district office, which serves southern New Jersey, eastern Pennsylvania, Delaware, and Maryland. Rogers heads the New London, Connecticut, sales office, which serves western Connecticut and Massachusetts.

Minnesota Rubber expands again

For the fourteenth time since 1946, Minnesota Rubber Co., Minneapolis, has expanded. This time, they added 12,000 sq. ft., which will house rubber mixing equipment and twelve electrohydraulic presses. Total manufacturing area is 120,000 sq. ft.



Do you have pipe lines through which constant flow is a critical factor? Could slowdown or stoppage cause untold damage to valuable equipment? If it's important that you know what's going on inside a pipe line . . . Nugent Sight Flow Fittings can be one of the most economical investments you've ever made.

These fittings have large double windows to aid visibility. A spring compensated, hinged, indicator gate moves in proportion to the flow and is visible from either side, even when liquid is dark or discolored. Fittings available with electrical contacts to operate a bell or light should liquid flow cease. Sizes ⅜" to 6" inclusive . . . in brass, cast iron, and steel. Tapped or flanged.

Complete data upon request.

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OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

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Valve Controls, Inc. expands in North Hollywood

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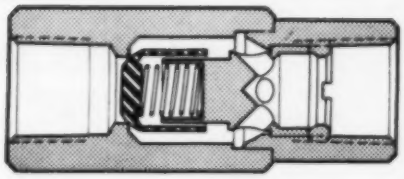

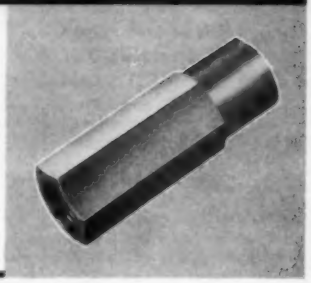

- Insures pressure for pilot operated valves
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- Large capacity — small size
- Non-adjustable — 15, 45 or 65 psi
- For oil to 3000 psi
- Sizes— 3/8", 1/2", 3/4", 1", 1 1/2", Pipe (NPFT)

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THE BIGGEST BOOSTER BARGAIN EVER OFFERED!

IT'S AIR HYDRAULIC!
Delivers over 3 cu. in. at 3000 psi for less than $100!

It's true! Mass production for our own air-hydraulic products enables us to offer the Wilton high output-pressure booster at half the usual cost! Simple, rugged construction, designed to operate more than a million cycles without maintenance. Easily replaceable seals; wiper cup protecting main seal; anti-friction hydraulic piston; pressed bronze filter in breather hole. Air cylinder and piston are non-ferrous and corrosion proof. Dependable performance proven by thousands of installations. Lower pressures also available. Get the facts about this booster bargain today!*

ATTACH THIS AD TO YOUR LETTERHEAD AND MAIL FOR FREE LITERATURE!

* O.E.M. inquiries invited, and will be quoted discount prices. Quotations for unusual requirements submitted on request.

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Schiller Park, Ill. AHP-30

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DPU-5-3000

DPU-15.5-1500

HYDRAULIC "AUTOMATION" "HI-LO" PRESSURE PUMPING UNITS

Above Pumping Units give total volume of both pumps until cut-out pressure of the large volume-low pressure pump reaches the maximum setting of the unloading valve. The low volume-high pressure pump takes-over until maximum setting of unloader or relief valve on high pres. circuit is reached.

(1) No. DPR-21-1500 – A 21 GPM PUMPING UNIT and RESERVOIR

An ideal unit for any application where a fast approach to work load is needed. Delivers 21 GPM at 1500 PSI with a 5 HP, 220/440 V., 3-phase, 60 cycle AC motor. Has 17 GPM large volume, low pressure pump which can be set to unload from 50 to 450 PSI. Also a 4 GPM low volume, high pressure pump which can be adusted to 2000 PSI. As shown mounted on 31 gallon reservoir (available w/o reservoir) 625.00

(2) 5 GPM – 3000 PSI PUMP UNIT

Has a 3 HP, 220/440 V., 3-phase, 60 cycle AC motor. The large volume, low-pressure pump is a variable displacement type. Has 3-1/2 GPM volume and automatically unloads at 600 PSI. The low volume, high pressure pump delivers 1-1/2 GPM at 3000 PSI. Fixed displacement type. Pressure must be controlled by external relief or unloading valve.
No. DPU-5-3000 as shown . . 310.00

Same as above but mounted on a 18 gallon reservoir 535.00

(3) 15-1/2 GPM – 1500 PSI PUMP UNIT

Has 3 HP, 220/440 V., 3-phase, 60 cycle AC motor. Large volume, low-pressure pump delivers 14 GPM up to 300 PSI. A fixed displacement type. External unloading valve must be used. The low volume, high pressure pump delivers 1-1/2 GPM at 1500 PSI. Fixed displacement. Unloading or relief valve must be used to control the pressure.
No. DPU-15.5-1500 as shown . . 249.50

Same as above but mounted on an 18 gallon reservoir 525.00

SPECIAL 25 GPM PESCO PUMP

A special Palley Government Surplus Value. Positive Displacement type. Delivers 25 GPM at 3450 RPM. Pressure limit is 500 PSI continuous or 1000 PSI intermittent. Cat. No. H-P25SU Without pump mount. ONLY 27.95

PUMP MOUNT – As shown on pump above. Has sealed-in bearings and 4-hole foot mount . . . . . Only 16.95

WEBSTER HYDRAULIC POWER DRIVE

Designed for U.S. Navy to remotely elevate large guns. Has 3500 RPM, 5 HP (intermittent), 3 HP (continuous), 220–440 Volt, 60 cycle, 3-phase motor. The motor hooked to a Vickers heavy duty, variable volume reversible pump – No. P-V 2003-S108. Pump delivers approx. 7 GPM. Also included is elect. controls

Originally cost approx. $2000 $195

WOOSTER – 4500 RPM DYNAMOMETER TEST STAND

To check Torque on pumps, fluid motors, generators, etc. Complete with 10 HP, 1725 RPM, 220/440 V AC, 3-phase, 60 cycle motor. Motor drives a 5 KW, DC Generator to supply current for a 5 HP, DC Variable speed motor. Stand has a torque scale and tachometer. Comes with complete power panel; a Rockwell 20 GPM rotary flow meter; an 85 GPM, 3,000 BTU Ross heat exchanger and a large volume Cuno Air Filter. NOW.. $1475

New Hydraulic Cylinders

Designed to meet the most rigid requirements of industry. All are heavy duty steel. Shown here are 2 of our line.

Available in heavy duty press type cylinders of 3", 5", 6" and 8" bores – thrust up to 75 tons. Also in internal cap types as at right above – with up to 4" bore and up to 18,850 lbs. of thrust at 1500 PSI. Write for complete list of Special Palco Hydraulic Cylinders.

HYDRAULIC TEST STAND BARGAINS

A GREER Test Stand. Capacity of 20 GPM at 5000 PSI with a 60 HP, 220/440 V., 3-phase AC motor. Complete with a Denison 700 series, variable displacement pump. Console stand is 7 ft. high x 12 ft. long. . . . . NOW ONLY $4500.00

HYDRAULIC TEST STAND – With 30 HP, 220/440 V., 3-phase AC motor. Delivers 20 GPM at 3000 PSI. Has a Vickers variable displacement pump. A Surplus Bargain $2500.00

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POST SCRIPTS OF INDUSTRY

consultant. He will handle the southern, southwestern, and western territories. William T. Nystrom is distributor sales manager. He is in charge of New England and Canada. Edwin R. Weeden is assigned to the Middle Atlantic area, and Robert F. Kippax handles the Midwest. Nystrom, Weeden, and Kippax were with the Industrial Products Division, which will no longer sell pumps.

Beswick is sale engineer for Bendix Filter Division

Albert N. Beswick will cover the Middle Atlantic states for Bendix Filter Div., Bendix Aviation Corp., Madison Heights, Mich. He will work out of Hackensack, N. J. He was with Harwell Aviation Supply Co., Los Angeles, and Curtiss-Wright Corp.

New distributors

Stanley M. Proctor Co., Inc., Cleveland, Ohio, will cover northern Ohio for Republic Mfg. Co., Cleveland.

Hope Rubber Co., Inc., Fitchburg, Holyoke, and Watertown, Mass., and Hartford, Conn., will distribute the Crown line of compressed air units made by Hannifin Co. division, Parker-Hannifin Corp., Des Plaines, Illinois. *W. E. Thew Supply Co., Inc.*, Green Bay, Wis., will handle the Crown line. *M&M Supply Co.*, Dallas, Texas, will distribute the Crown line, and tube and hose fittings made by Parker Fittings & Hose Division, Cleveland, Ohio. *Industrial Technical Sales & Service, Inc.*, Mansfield, Ohio, and *Depatie Fluid Power Co., Inc.*, Kalamazoo, Mich., will handle fittings and hose.

Holden Engineering Co., Cleveland, Ohio, will cover northern Ohio for Automatic Valve Co., Farmington, Mich.

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THE COMPLETE PACKING UNIT
for Hydraulic or Pneumatic rods and cylinders

MON-O-PAK® CARTRIDGE

- Easily and quickly installed.
- No adjusting necessary.
- Equipped with Anti-Backlash rings.
- Includes Seal-Guard® rod wiper.
- Low friction coefficient.
- Shock and burst proof.
- Reduces initial machining cost.
- Gives longer service life.
- Cuts machine down-time.
- Easily removed for replacement.

Write for catalog and prices.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Road, Warren Mich.

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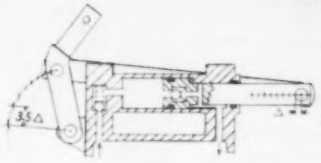
Tog-Oil®
DOUBLE ACTING DIFFERENTIAL PLUNGER HAND PUMP

Uses Only Two Check Valves



- For even increments of piston movement, handle movement increases at left end of stroke
- Mechanical advantage 3.5:1

Model 1772 has ½ gallon reservoir, needle type release, and safety valves for 1000 to 2000 P.S.I. Other models available for pressures to 10,000 P.S.I.

We also manufacture

- Kingsbury Slipper Type rotary hydraulic pumps for pressures to 2000 P.S.I.
- Hydro-wheels for self-propelled lifters, with 360° steering and reverse.

DEPT. M-3

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STAFFA

HIGH TORQUE VARIABLE SPEED (1-100 r.p.m.) HYDRAULIC MOTORS

Three Models now in production:
Mark III—5 cylinder 3,500 lbs. ft. at 1,500 p.s.i. (Speed 1-100 R.P.M.) **Mark IV**—5 cylinder 4,500 lbs. ft. at 2,000 p.s.i. (Speed 1-100 R.P.M.) **Mark V**—7 cylinder 6,600 lbs. ft. at 2,000 p.s.i. (Speed 1-75 R.P.M.) Overall efficiency 90% to 95%. Ideal drive for conveyors, rolling mills, cranes, tractors, drills and most mechanical handling applications.

Ask for details of hydraulic cylinders, valves, pumps and motors.

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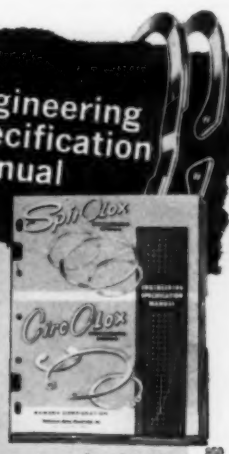

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You are cordially invited to investigate a career opportunity with a well established corporation if you meet the following qualifications:

Education: B.S.M.E. or B.S.A.E., advanced degree and/or study desirable.

Experience: Five or more years experience in design and development of high pressure piston pumps and motors for hydraulic power transmission systems used in aircraft, industrial and mobile application.

Duties: 1. To aid in initiating and carrying out an R&D program for development of pumps and motors for advanced hydraulic power transmission development programs.

2. To supply design know-how on pumps and motors and/or advanced power transmission systems.

3. Set up and carry out R&D program for development of pumps and motors for mobile equipment including industrial and defense products.

Commensurate salary—educational opportunities—professional development program—attractive Chicago suburb. Write in confidence to:

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Mr. L. J. Borkowski

ROY C. INGERSOLL RESEARCH CENTER

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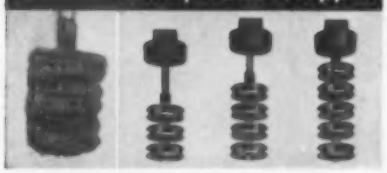
Des Plaines, Illinois

NEW MAGNETIC CLEANER for HYDRAULIC POWER UNITS the Kebby Tank-Trapper



- ★ Powerful Alnico V Magnets
- ★ Highest Active Area
- ★ Engineered for Power Concentration
- ★ Easy to Apply
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- ★ No Moving Parts . . . No Maintenance

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The Kebby Tank-Trapper is specifically designed to complete the protection of hydraulic systems against damage by iron particles worn off moving parts of various components. It picks up material missed by the filter and prevents premature filter loading. Expensive shut downs and service calls are drastically reduced. Write for Bulletin 1-500-59.

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2320 Custer Avenue Rockford, Illinois
Designers and Manufacturers of Magnetic Devices, Kebby Mite and Filtray Coolant Cleaners

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When replying to a box number in the Market Place, address your letter to Applied Hydraulics & Pneumatics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

REPRESENTATION WANTED

Exclusive sales representation in the following areas: Milwaukee and St. Louis. Top lines of rotating and non-rotating pneumatic and hydraulic cylinders, and high production power chucking equipment. Reply with exact territorial boundaries, number of salesmen in field, products now being sold and principal's names. Send reply to Box 3160, APPLIED HYDRAULICS & PNEUMATICS.

MISSILE FLUID POWER COMPONENT DEVELOPMENT

Major midwestern manufacturer with R & D center in Cleveland area has key opening for creative engineer with supervisory ability and practical experience in missile fluid power component design. Unusual opportunity for rapid advancement with company just entering this field, for qualified engineer. Excellent model shop and lab facilities available. Send resume to Box 3260, APPLIED HYDRAULICS & PNEUMATICS.

HYDRAULIC ENGINEER

An exceptional opportunity is available for an experienced hydraulic engineer to be responsible as lead engineer in well established company. Manufacturer of hydraulic pumps, valves, motors, cylinders for mobile equipment and industrial market.

Applicant must be acquainted with design characteristics, casting design, and design layout on product development.

Submit qualifications such as age, experience, health, salary expected, photo, etc.

This position assures excellent future. Reply to ZENO HYDRAULIC CORPORATION, 630 West 17th South, Salt Lake City, Utah.

WANTED SALES ENGINEER

Established fluid power distributor in Eastern Penna. area offers attractive territorial and commission arrangement for qualified individual. Replies held in strict confidence. Write Box 3360, APPLIED HYDRAULICS & PNEUMATICS.

ENGLISH AGENT WANTED

Agent required with suitable background for the sale of a wide range of tube, pipe and bar bending machines, hydraulic equipment and hydraulic motors. Commission basis. Territory West London, Hertfordshire, Middlesex, Buckinghamshire, Surrey, Oxfordshire and Berkshire. Write to Box 3460, APPLIED HYDRAULICS & PNEUMATICS.

DIESEL PROJECT ENGINEER

Design and/or Laboratory experience in fuel injection or diesel engineering field capable of independent design and project engineering work on diesel fuel injection equipment. High speed engine experience desired. Immediate opening for qualified applicant.

Mutually satisfactory arrangements will be made for personal interview.

Write letter of application giving full particulars to:

Scintilla Division
Bendix Aviation Corp.
Sidney, New York

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SYSTEMS ENGINEER: To assume project responsibility for development of electro-hydraulic servocontrol systems for aircraft, missiles and ground support equipment. Duties will involve performance of static and dynamic analysis of servo systems, technical liaison with customers, and proposal preparation.

PROTOTYPE ENGINEER: adapt basic designs; trouble shoot and evaluate components to establish producibility and reliability; perform technical liaison with customers.

These and other engineering positions offer you unusual professional advancement in the dynamic field of electrohydraulic servocontrols. The advantages of small company atmosphere in a suburban environment, the merits of profit sharing, and the prestige of industry leadership are yours with . . .

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East Aurora, New York

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- **Easiest Possible Installation on any wall thickness**
- **Large Face for Better Visibility— 7" Overall**
- **Can be used with non-inflammable oil**
- **Leak-Proof — No Dripping**
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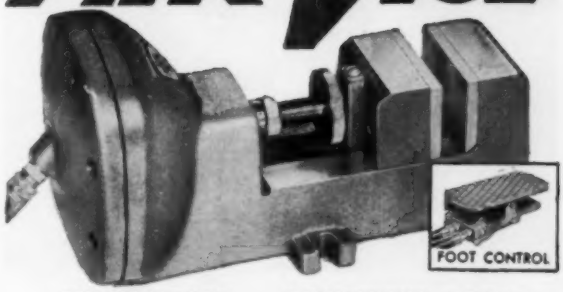

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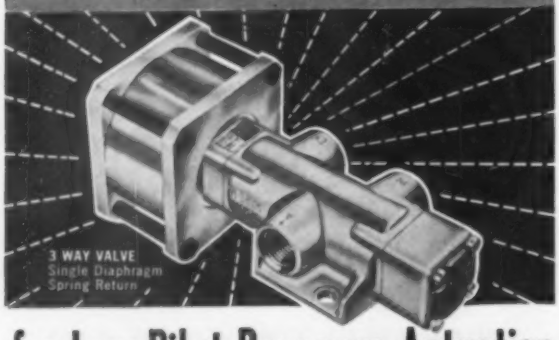

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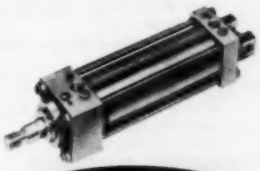

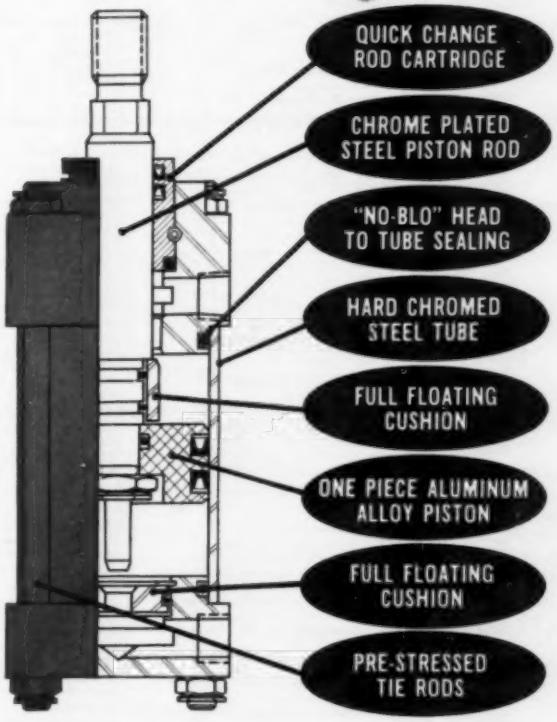
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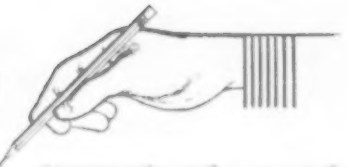

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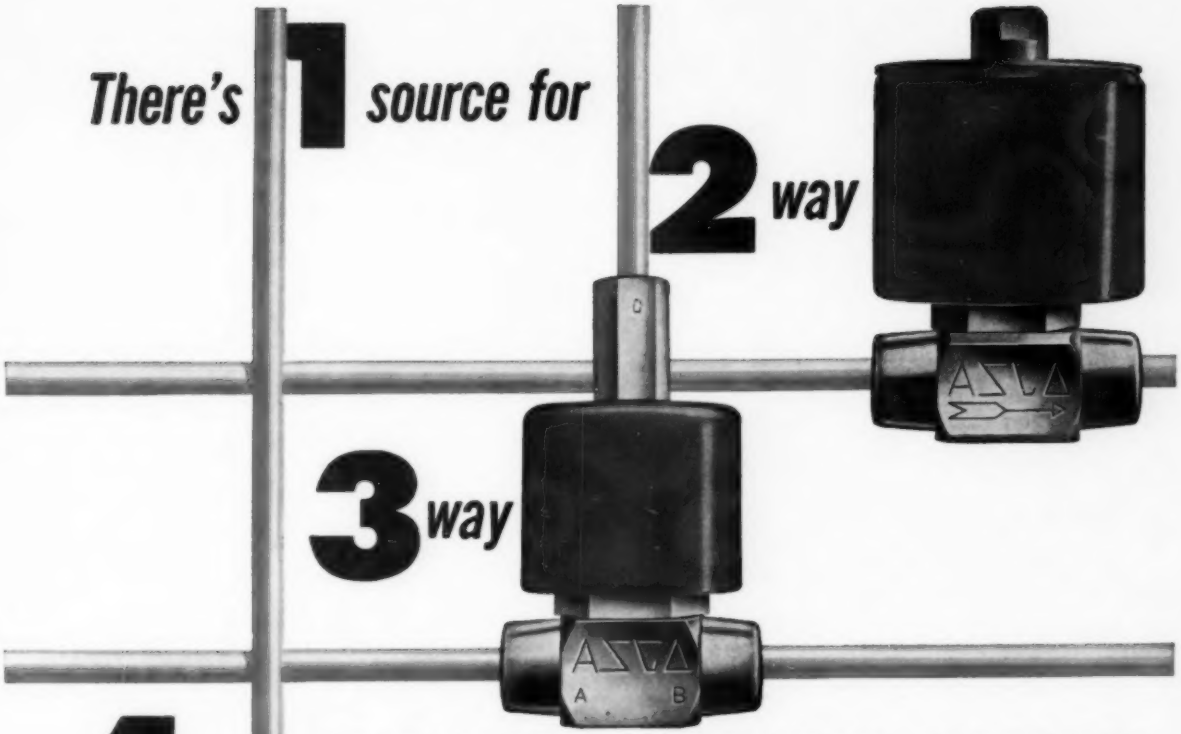

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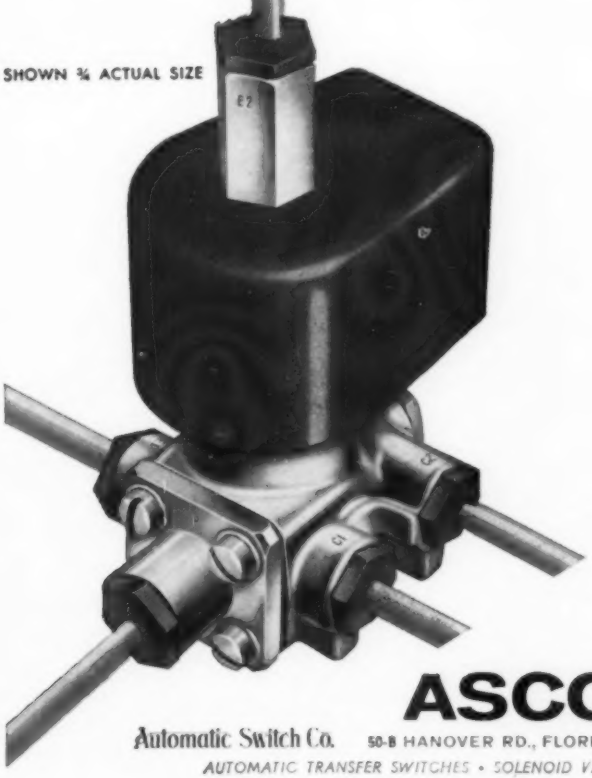

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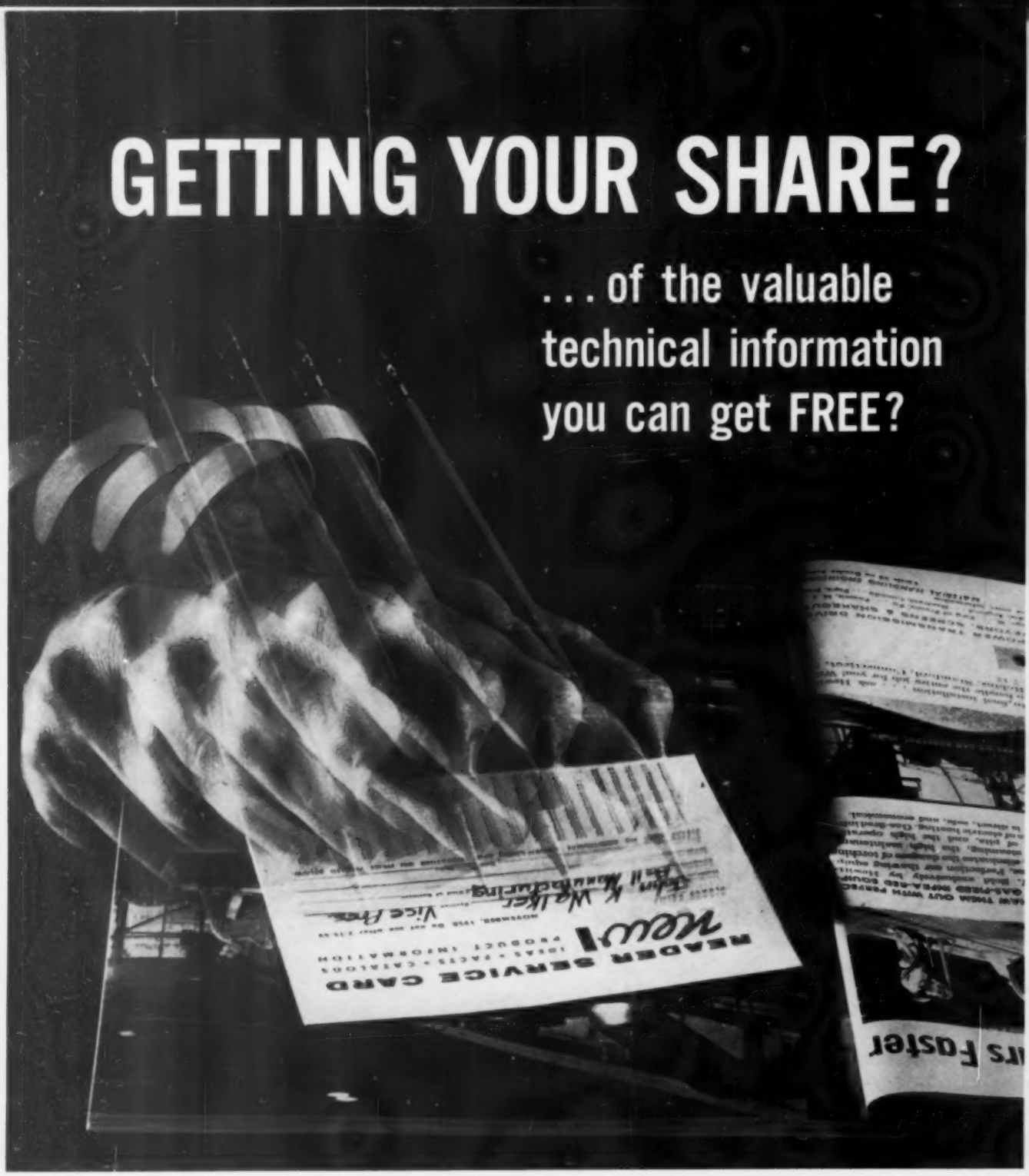

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